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A

MONOGRAPH

OF THE

BRITISH MARINE ANNELIDS.

VOL. IV.

POLYCHÆTA—

HERMELLIDÆ TO SERPULIDÆ

WITH ADDITIONS TO THE BRITISH MARINE POLYCHÆTA DURING THE
PUBLICATION OF THE MONOGRAPH.

BY

WILLIAM CARMICHAEL McINTOSH, M.D. Edin.,

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COMMISSION UNDER LORD DALHOUSIE, 1883-1885; SCIENTIFIC MEMBER OF
THE FISHERY BOARD FOR SCOTLAND, 1892-1895; MEMBER OF
THE IRISH INLAND FISHERIES COMMISSION, 1899-1901, ETC.

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PREFACE TO THE FINAL VOLUME OF THE MONOGRAPH.

IN concluding this monograph of the British Marine Annelids the author is aware that there are many gaps to fill in literature, anatomy, physiology and development, but he hopes that they are left in a better state than he found them, thanks to the greater attention zoologists in every clime have bestowed on the Marine Polychæts since he took them in hand. Indeed, as formerly stated, it was their neglected condition in the later fifties and early sixties of last century which prompted him to attempt something for their improvement. At least the treatise will give a foundation to the work of those who may follow, and conserve the time and labour so readily absorbed in the study of the group.

To previous workers in this country, such as Borlase, Montagu, John Graham Dalyell, George Johnston, Wm. Baird and Thomas Williams, he would render a grateful tribute, whilst abroad the valued labours of O. F. Müller, O. Fabricius, H. Rathke, Delle Chiaje, Milne Edwards, Grube, De Quatrefages, Michael Sars, Claparède, Alex. Agassiz, Leidy, Stimpson, De St. Joseph, Marion, Giard, Langerhans and many others¹ keep their memories ever fresh.

To the zoologists in the early sixties of last century who cordially supported the study of the Marine Polychæts, viz., Professors Allman, G. Busk and T. Huxley, Lord Avebury, Dr. Baird, Mr. Spence Bate, Dr. Gunther and others, I owe much, and to none more than Prof. G. Busk. Moreover, the care taken by Dr. Gwyn Jeffreys and Canon Norman in their various dredging expeditions to secure good specimens merits grateful record.

Much good work has recently been done by Mr. Southern on the rich western coasts of Ireland, where rare and new species have rewarded his investigations under the Irish Fishery Department. In the same way the facilities for research on the southern coast afforded by the Marine Biological Laboratory at Plymouth have added largely to our knowledge, and the labours of Prof. Goodrich, Dr. Allen, Mr. Potts, Dr. Orton and others of the staff deserve special commendation. In the same way the increased facilities offered by the ships of the Fishery Board for Scotland have enabled Wm. Small and James Watson Pryde to extend our information of the Polychæts. The work of Mr. Arnold Watson, as well as his ready courtesy in sending specimens and figures, and this throughout many years, has likewise been a noteworthy aid. Sir Ray Lankester, Prof. J. Arthur Thomson, Prof. Ashworth, Mr. Gravely, Dr. H. C. Williamson, of the Fishery Board's Marine Laboratory at Nigg, Aberdeen, Dr. A. T. Masterman, Prof. Punnett, Dr. Crossland, Miss Florence Buchanan, Prof. Garstang, Mr. H. E. Quick, of Swansea, Dr. Annandale, of

¹ *Vide* Preface to Part II, p. viii, 1900.

Calcutta, Major Elwes, the late Prof. G. Brady and others have also courteously sent various specimens. Extended investigation further demonstrates the world-wide distribution of many species.

Abroad, the recent labours of Professors Caullery and Mesnil, of Professors Pruvot and Racovitza, of Prof. Fauvel, of M. Malaquin, of Prof. Roule, of Prof. Ehlers of Göttingen, the late Prof. Appellöf of Bergen, Prof. Nansen of Christiania, Professors Arwidsson, Théel and Wirén of Sweden, of Tauber and Levinsen of Copenhagen, of Dr. Horst of Leyden, Prof. Gilson of Louvain, Dr. Marenzeller of Vienna, and the fine monographs of Dr. Hugo Eisig, have been valuable. The work of Panceri, Lo Bianco, Carazzi, Bernardi and others in Italy is also noteworthy. The researches of Messrs. Webster and Benedict, of Parlin Johnson, Aaron Treadwell, Percy Moore and Miss Bush in the United States of America have notably advanced the subject, as also those of Dr. Whiteaves and Mr. Chamberlin in Canada, and Sig. Rioja in Spain. The work of Prof. Haswell of Sydney, Prof. Benham of Otago, and the collections of Prof. Gilchrist at the Cape, have all been of signal service.

Occasionally a quotation is made from a separate copy of a paper which differs in pagination from the original as it appeared in a journal or in the transactions of a society. This could easily be obviated by keeping the original pagination in the reprint, as many publishers now do.

I have to acknowledge the help of Mr. White, the Librarian of the Royal Society, the late Mr. Riseley of the Linnean Society, the late Mr. Waterhouse and Mr. Martin Duncan of the Zoological Society, of Dr. Maitland Anderson and Mr. Smith of the University Library, St. Andrews, all of whom, with a ready courtesy, have for years helped.

No classification of the Polychæta hitherto published is satisfactory, the most reasonable being that adopted by Malmgren, and which has been followed in this monograph.

It may be explained that throughout the work the initials E. M. refer to the author's mother, who, whilst he was for many years sixty miles from the sea, enabled him, by a constant series of specimens, to work up the marine annelids as well as the general fauna of St. Andrews, most of these specimens being now in the St. Andrews University Museum. The initials R. M. refer to his sister, fellow-worker and artist (afterwards Mrs. A. Gunther), and A. M. and E. M. to two other sisters who helped him with specimens for many years. In this connection it is interesting to note the change which has taken place in the ways of the fishermen, from whom the foregoing procured many rare marine animals. In former days the lines were brought ashore in baskets with all the faunistic treasures attached, and these could be picked out by those interested—if they were not already set aside by the men themselves. Now nets have largely superseded lines, and these are gone over in the boats in the harbour so that they come less under the eyes of the naturalist. Yet rare fishes or abnormalities in fishes are still brought under notice by the men. It is curious that the curtailment of line-fishing or a change of ground no longer gives, for instance, the strange sight of many glutinous hags swimming in the harbour after removal from the lines, the hook being still fixed in each, and no longer brings to shore the swarms of *Pelonaia* and multitudes of the phosphorescent *Pennatula*, as well as many rare annelids and mollusks.

I have to thank the Carnegie Trust for their liberality in subsidising the coloured plates throughout the work. Without such aid it would have been impossible to have completed the task within a reasonable time. To the Royal Society I am also indebted for various grants in aid of the plates, and to Lord Rothschild for his generous help.

I have, further, to acknowledge the skilful and patient labours of Miss Ada H. Walker, who for many years has, with rare ability, drawn the annelids from life and represented the typical structures under the microscope. She has worthily followed in the steps of Col. Montagu's niece, Miss D'Orville, the beauty of whose coloured drawings of Sabellids in the manuscript volume in the Linnean Society (*e. g.* Plates 19 and 20) can hardly be exceeded, and of my sister, whose exquisite early drawings encouraged me to take this work in hand. It has to be remembered in connection with the drawings of some of the bristles that the very minute spines are sometimes invisible after preservation, and so with the cilia on most organs.

To the Council of the Ray Society I owe that generous support which has, during almost sixty years, been a source of sincere satisfaction. Finally, to the various secretaries of the Ray Society, the late Dr. Wiltshire and the late Mr. Hopkinson, and to Dr. Calman, the present secretary, I am indebted for much valued criticism and aid in the revision of the text and in references to the literature of the subject.

W. C. M.

GATTY MARINE LABORATORY,

ST. ANDREWS;

September 30th, 1922.

The Council of the Ray Society have again to express their gratitude to the CARNEGIE TRUST FOR THE UNIVERSITIES OF SCOTLAND and to Prof. McIntosh, who have generously contributed to the cost of producing the final part of this work.

The thanks of the Council are also due to Mr. G. A. Smith, who voluntarily undertook the tedious labour of compiling a complete index to the names and synonyms mentioned in the whole work, and who has also prepared a bibliographical collation of the parts in which it has been issued, giving the dates of publication as exactly as it is now possible to ascertain them.

Finally, the Council believe that they are interpreting the feelings of the members of the Society in offering to their President congratulations on the completion of this Monograph, of which the first part was published no less than half a century ago.

March 16th, 1923.

ERRATA.

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PAGE

75. The reference to Plate CXVIII, fig. 11, under *Sabellides octocirrata*, for body read tentacle.
83. The reference should be Plate CXXV, figs. 1—1 *b*, under *Melinna cristata*.
126. The reference to Plate CXIV, fig. 6, under *Polymnia nesidensis*, should be removed.
137. 8 *e* should be 8 *d* in the list of figures under *Lanice conchilega*.
149. For Genus CXLVII read CXLVIII.
150. Remove 6 *a* from the list of figures of *Nicolea venustula*.
209. For Genus CXL read CLX.

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339. *Filograna implexa*. Add Plate CXVI, fig. 5*b*—body, with operculum and ova, fig. 8—operculum.
386. In table, delete “*S. granulatus*, L.”

Note.—The same letters are used in the text-figures as in the previous part, with the following additions:

- br.* Bristles.
brv. Branchial vessels.
bv. Blood-vessel.
c. Lobe of collar.
ch. Chordoid skeleton.
gl. Thoracic gland.
m. Special ventral longitudinal muscle.
so. Duct of thoracic gland.
vert.m. Vertical muscles.

FAMILY XXX.—SABELLIDÆ—*continued*.*Genus* CLXIV.—BRANCHIOMMA, *Kölliker* (Clap. revis.), 1858—*continued*.1. BRANCHIOMMA VESICULOSUM, *Montagu*, 1815—*continued*.

The *body* is somewhat elongate, a large example reaching 100—110 mm., with a breadth of 3—5 mm., flattened, and tapered toward the tail, in front of which some have the widest part of the body. At the tip is the crenate anus. The dorsum is rather more distinctly flattened than the ventral surface, and has a groove in front leading to the branchial fissure, whilst posteriorly it bends to the right between the eighth and ninth bristle-tufts, and slants to the posterior edge of the ninth bristled segment. The ventral surface has the somewhat prominent median region occupied by the scutes, the first of which, on the united buccal and first segment, is the largest, and is characterized by a dimple in front. It is followed by eight others, each of which may have an even margin, or a median incurvation. The last of the anterior scutes has posteriorly a median projection to which the boundary line from each side slopes. From this point the ventral median groove passes backward to the tail, cutting the succeeding scutes into two equal halves, occupying a little more than a third the breadth of the body of the preserved specimen, except toward the tail, where the scutes are somewhat broader and the median groove is wider. The anterior region has nine segments, with a wider antero-posterior diameter than those which follow, whilst these again are wider than the caudal segments.

The colour of the body is dull orange or of a salmon hue, universally and minutely dotted with white grains. The dorsal collar is pale, and is also minutely dotted with white grains. Ventrally the split flaps are also pale, with a brownish edge—well marked in the anterior dimple of the first shield. The ventral scutes are paler, but also minutely dotted with white, and the ventral groove is reddish. The cilia of the anterior dorsal surface carry loose bodies actively forward.

The alimentary canal appears to agree generally with that of *Lanice conchilega* in having a simple oesophagus opening into a more or less undifferentiated stomach, the sacculations commencing anteriorly and continuing to the anal region posteriorly.

The anterior region consists of nine segments (six to nine, De St. Joseph), eight of which bear pale golden bristle-tufts which slope in the preparations upward and backward. The first tuft springs from a setigerous process almost immersed in the tissues of the united first and buccal segments, but the posterior cirrus or process is distinct though small. The bristles are simple, tapering forms, with very narrow wings (Plate CXXVIII, fig. 4), and in two series, viz., a larger series, more deeply tinted yellow by transmitted light, and minutely dotted, and a smaller more translucent series. All have finely tapered and nearly straight tips. The rest of the setigerous processes of the region are characterized by

an increasing prominence, and the posterior papilla is considerably larger. Each arises from a broad base, and is somewhat flattened, since the vertical exceeds the transverse diameter, and the distal end has three parts, viz. the posterior process or papilla (not to be confounded with either a dorsal or a ventral cirrus), which springs from the middle posteriorly, and two areas for the bristles. The papilla is short and nearly cylindrical in the preparations, and is directed backward. The upper bristles (Plate CXXVIII, fig. 4a) arise from a curved area above a papilla, so that the long axis of the row is antero-posterior, and the convexity of the tip with the wings is turned outward and their points directed backward. They have long shafts and finely tapered, slightly curved tips, with narrow wings. The inferior row of bristles again has its long axis vertical, and the bristles have shorter and stouter striated shafts (Plate CXXVIII, fig. 4c), shorter tips and broader wings. The tip in all is finely pointed.

The bristles of the second region are arranged like the inferior group in front, viz. with the long diameter of the row vertical, and they spring from the tip in a double row—that is, on each side of a ridge of tissue. The wings of these are intermediate in character, being narrower than the lower series and wider than the upper series of the first region. Their tips, however, are long and finely attenuate, especially the upper forms. The chief changes in the bristles toward the tip of the tail are the shortening of the shafts and the great elongation of the tips, which stretch from each side of the flattened body as finely tapered hairs (Plate CXXVIII, fig. 4b). A distinct curvature occurs at the commencement of the wings. The anterior rows of hooks occupy the summit of the rounded ridge, which begins close to the setigerous process and passes ventrally near the scute. Each hook (Plate CXXVIII, fig. 4e) is avicular in shape, with a marked forward curvature of the posterior outline at the crown, a powerful and sharp main fang with a series of very minute serrations above it, a neck of moderate length and a long tapering base. Bold striæ pass from the crown to the base, into which they curve a little behind the prow. Each hook is accompanied by a short, broad bristle with a spatulate tip bent at an angle, and ending in a point, or when seen obliquely the tip is hastate or on edge hook-like. In a specimen from South Devon, in the British Museum, both these and the hooks had their “heads” tinted brown. The posterior hooks (Plate CXXVIII, fig. 4f) are smaller, with a shorter neck and shorter base, and more distinct serrations above the main fang.

Neural canals occur from the second setigerous segment backward. The modified segmental organs are found in the first, second and third setigerous segments, and they open by a common canal on the dorsum. Brunotte describes those of the ordinary type in the posterior region, and he limits the anterior pair to two segments.

Reproduction.—Lo Bianco (1909) finds the period of sexual maturity to be from August to October at Naples, where it is termed “Fiucchetiella d’arena.” The young examples of 8–20 mm. progress with the tail in front. The number of the branchiæ varies from fourteen to sixteen. The first two have an eye always larger than the others. The first thoracic segment is less completely fused with the buccal than in the adult, and shows two reddish ocular specks placed at the base of the branchia on each side. The first thoracic segment bears the otocysts and their otoliths. The bristles of the region are more spatulate than in the adult. The anal segment ventrally is in two lobes separated by the “coprogogue,” whilst on the dorsal surface are four to eight ocular specks which disappear in the

adult just as the cephalic eye-specks of the young Eunicids disappear in the adult. The examples from Dinard are much less than those from Devon (De St. Joseph).

Habits.—It is an exceedingly wary form, and when kept in confinement is chary of exhibiting its beautiful branchial apparatus, even the vibration caused by a foot on the floor causing it to withdraw with lightning-like rapidity. The ejectamenta are passed out of the anterior end of the tube as usual in such forms. When removed from its tube it slowly rolls in the vessel, elongating and contracting its body, and gently moving its branchiæ.

The *tube* (Table CXV, fig. 2a) is leathery internally, coated externally with coarse sand intermixed with fragments of shells (Montagu). It is sometimes attached to stones at considerable depth as well as occurs between tide-marks in the midst of colonies of *Sabella penicillus* (De St. Joseph). Red and other algæ occasionally form tufts on it. The anterior end is flexible and elastic, so that it spontaneously closes and often curls up when the branchial fan is withdrawn.

Claparède (1868) observes that the violet hue of the posterior region is absent in the Neapolitan variety, and that the eyes are proportionally much less than in *B. Köllikeri*. The ciliated ventral groove divides into two limbs, one passing between the tenth and the eleventh, and the other between the ninth and tenth segments to the dorsum. After fusion the groove attains the mid-dorsal line at the eighth segment. Claparède thought that the coarser nature of the tube in the English form might indicate specific distinction, but such does not appear to be the case. Finally, he is not quite sure but that his *B. Köllikeri* may be a young stage of this species, and if such should be the case, it is interesting that the great size of the eyes is parallel to the condition common in young fishes. However, he notes the divergences of the collar; the absence of the branchial filaments from their special position, and the absence of the muciparous follicles in the “antennæ” of *B. vesiculosum* as points requiring further consideration. Claparède (1870) found an allied species (*B. vigilans*) as a commensal on *Aphrodita aculeata* at Naples, its tube either lodged amongst the hairs, and stretching from head to anus, or between two feet not far from the posterior extremity. Behind the stomach the epithelium is radiate in its arrangement, a rosette of long fusiform cells having a centre pierced with pores.

Oerley¹ (1884) gave a careful account of the structure of the skeletogenous elements in *Branchiomma*, pointing out the arrangement of the muscles, vessels, nerves and other parts in the branchial filaments, and the connections of the supporting tissue at the base of these organs. He concludes by a disquisition on the homologies of these parts with those of vertebrates.

Ehlers² (1887) describes *Branchiomma bioculatum*, from Florida, but as the eyes in the European form are essentially double, a re-examination may alter the view as to the form being new.

Fauvel³ (1902) describes the otocysts of this form as communicating with the exterior by long ciliated canals, and with cilia in the otocysts, so that the grains of quartz therein are in motion.

¹ ‘Mit. Zool. Stat. Neap.’ Bd. v, p. 217, Taf. xii and xiii, fig. 15.

² ‘Florida Anneliden,’ p. 260, Taf. liii, figs. 1—9.

³ ‘Comp. Rend. Acad. Sc. Paris,’ December 29th, 1902; and ‘Comp. Rend. Congrès internat. Zool. Berne,’ 1904, pp. 360—364, 3 text-figs.

Rioja (1917) gives an account of a new species, *B. Linaresi*, from the shores of Cantabria (Spain), but so far as can be observed from his account and figures such may only be a variety.

A somewhat general account of the structure of a *Branchiomma* was given by Brunotte¹ (1888) from examples procured on the coast of France (l'Etang de Thau). Amongst other features he considers the two muciparous glands opening by a single dorsal pore anteriorly as modified segmental organs. He terms the chordoid supporting tissue of the branchial region "cartilaginous," but his account is good.

Lo Bianco² (1893) found an example with the distal end of a branchial filament bifid, each division having an eye. He also mentions having seen a specimen 2 cm. in length, with a trace of eyes on its filaments.

De St. Joseph (1894) found numerous Gregarines of a fusiform outline and like *Polyrabdina* of Mangazzini in the intestine.

Genus CLXV.—BISPIRA, Kröyer.

Amphitrite, Montagu; *Sabella*, Savigny; *Distylia*, De Quatrefages.

The collar forms a thick circular flap, from which each large lateral division passes downward and forward, to end in a smaller attachment at the side of the process of the first ventral scute. Ventral plate of each side overlaps the lamella. Branchiæ arise from a firm spiral base, and have the basal web and ocular specks on the outer edge. Body generally large, widest anteriorly. Bristles of the anterior region in two groups, viz. those with narrow wings, and those with flattened (knife-blade) tips. Anterior hooks avicular, commencing on the second segment, and similar though smaller posteriorly.

1. BISPIRA VOLUTACORNIS, *Montagu*, 1804. Plate CXIII, fig. 5—anterior ventral aspect; Plate CXV, figs. 1—1*b*—body, and 1*c*—young; Plate CXX, figs. 8—8*b*—body and anterior end; Plate CXXVIII, figs. 5—5*e*—bristles, hooks and branchia; Plate CXXXVI, fig. 22—anterior section.

Specific Characters.—Cephalic plate after removal of the branchiæ presents two semi-circles of firm chordoid tissue for the attachment of the branchiæ, and two bifid curved flaps over the mouth. From the outer base of the firm ridges at each side of the dorsal groove springs the collar as a thick curved flap from which the large lateral division passes downward and forward, to end in a smaller attachment at the side of the process of the first ventral scute. Overlapping the ventral edge of the lamella is the ventral plate of each side, with its triangular reflected flap, the anterior surface of which is of a rich deep brownish purple, bordered with white. The first ventral scute has two lunate depressions upon which the ventral lappets of the collar rest. The scutes are continued to the posterior end as elongated plates on each side of the median groove. From the firm spiral base the branchiæ pass forward to the number of forty to eighty, the filaments ending in a process with a web at each side.

¹ 'Recherches Anat. Gen. Branchiomma, Ecole Supér. Pharmacie de Nancy,' 2 sér., No. 16, pp. 1—77, pls. 1 and 2.

² 'Atti. Accad. Sc. Nap.,' vol. v, p. 69, Tav. iii, fig. 4.

One, two or three pairs of ocular specks on the outer edge. Body of moderate length (about four inches and eighty segments, Rathke), and ends in an anus, with pigment-specks; two ovoid papillæ beneath. Anterior region has nine bristled segments, but they may vary from five to eleven. Colour of the body brownish violet (De St. Joseph). Bristles of the

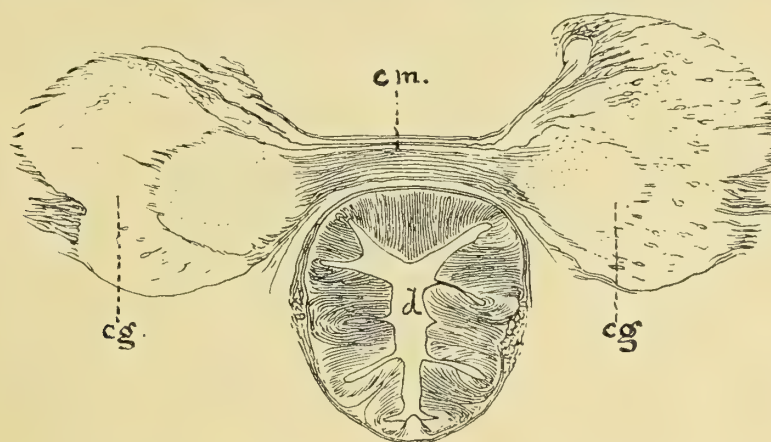


FIG. 151.—Transverse section through the cephalic ganglia of *Bispira volutacornis*. *cg.*, cephalic ganglia; *cm.*, commissure; *d.*, oesophagus.

anterior region golden and in two groups, viz., an upper series having long straight shafts and tapering tips, with narrow wings, and a dense brush of shorter forms with varying tips, some having tapered tips, with wider wings than the former series, whilst others form a “knife-blade”-tip in which apparently the wings are fused. In the caudal region the tips of the majority of the bristles are greatly elongated, and the shorter forms have serrated edges. The anterior hooks, which commence on the second segment, are avicular and in a

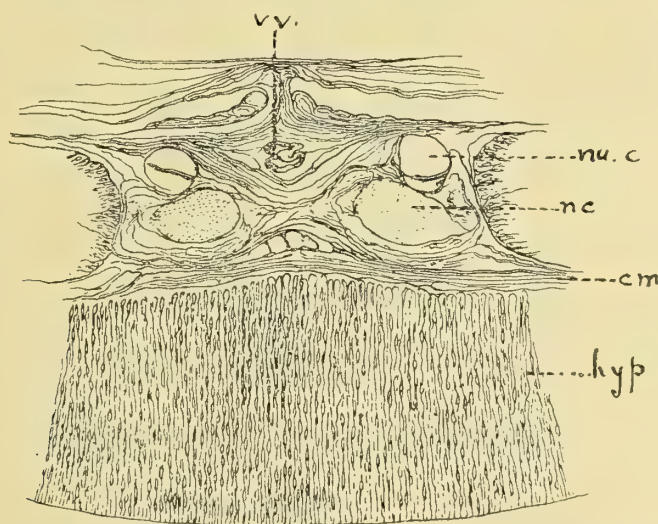


FIG. 152.—Transverse section through the great nerve-cords in the anterior region showing their relation to the surrounding parts; *cm.*, circular muscular coat; *hyp.*, hypoderm; *nc.*, nerve-trunks; *nu.c.*, neural canals; *vv.*, ventral blood-vessel.

single row, with long necks, from which the main fang arises at less than a right angle, and has eight or nine small teeth above it. The base is short and abruptly tapers to a point posteriorly. The posterior hooks are similar but smaller. Tube similar to that of *S. penicillus*, with a thinner posterior extremity and fixed to stones.

In transverse sections of the anterior region the structure of the brain is well shown in this form, with the great commissure over the œsophagus, Fig. 151. Moreover, the changes in the great cords and the neural canals are illustrated in Fig. 152 for the anterior, and Fig. 153 for the posterior region. Further, the origin of the skeletogenous elements which pass to the branchial filaments, the great vessels going to the system, and the arrangement of the grooves leading to the mouth, are demonstrated in Fig. 154.

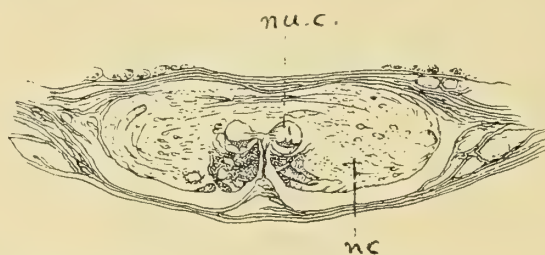


FIG. 153.—Transverse section of the great nerve-trunks in the posterior region. *nc.*, nerve-trunk; *nuc.*, neural canal. × Zeiss oc. 4, obj. A.

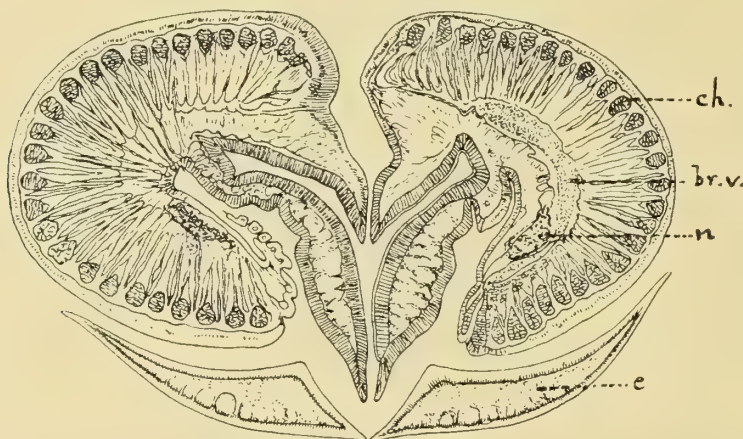


FIG. 154.—Transverse section through *Bispira volutacornis* at the base of the branchiæ. *br.v.*, branchial blood-sinus; *c.*, lobes of collar; *ch.*, chordoid skeleton; *n.*, nerve. × Zeiss oc. 4, obj. A.

SYNONYMS.

1804. *Amphitrite volutacornis*, Montagu. Linn. Trans., vii, p. 80, Tab. vii, fig. 10.
 1807. " " Turton. Brit. Fauna, vol. i, p. 136.
 1808. " " Montagu. MS. vol. Linn. Soc., pl. xi, fig. 1.
 1812. " " Pennant. Brit. Zool., iv, p. 89.
 1816. *Sabella* " Leach. Encycl. Brit., Suppl., p. 452, pl. xxvi, fig. 7.
 1818. *Amphitrite* " Lamarck. Anim. s. Vert., t. v, p. 367.
 1820. *Sabella* " Savigny. Syst. Annel., p. 81.
 1826. ? *Amphitrite Josephina*, Risso. Hist. Nat. Europe mérid., t. iv, p. 410.
 1828. " *volutæformis*, De Blainville. Dict. Sc. nat., t. lvii, p. 434.
 " " *volutacornis*, Stark. Elements, i, p. 155.
 1843. *Sabella* " Rathke. Nova Acta Cur., Bd. xx, p. 223, Tab. xii, figs. 1—4.
 1843–53. *Amphitrite volutacornis*, Chenu. Illust. Conch., 11^e livr., pl. vi, fig. 3.
 1845. " " idem. Bibl. Conch., t. 1^{er}, p. 33, pl. xii, fig. 10.
 " " " Johnston. Ann. Nat. Hist., xvi, p. 449.
 1846. *Sabella Josephinæ*, Grube. Arch. f. Naturges., p. 53, pl. ii, fig. 6.
 1851. " " and *volutacornis*, idem. Fam. Annel., pp. 89 and 140.

1865. *Sabella volutacornis*, Johnston. Cat. Worms. Brit. Mus., p. 262.
 „ *Diastylia* „ De Quatrefages. Annel., ii, p. 421, pl. xv, figs. 5—7.
 1867. *Sabella* „ Parfitt. Cat. Annel. Devon, p. 34.
 1870. „ (*Distylia*) *volutacornis*, Grube. Arch. f. Naturges., p. 336.
 1893. *Bispira Mariæ*, n.s., Lo Bianco. Atti R. Accad. Sc. Nap., vol. v, No. 11, p. 75, Tav. i, fig. 2, Tav. ii, fig. 4, Tav. iii, fig. 7.
 1894. „ *volutacornis*, De St. Joseph. Ann. Sc. nat., 7^e sér., t. xvii, p. 286, pl. xi, figs. 289—295.
 1904. „ „ Journ. M. B. A., vol. vii, p. 232.
 1906. „ „ Bohn. Ann. Sc. nat., 9^e sér., t. iii, p. 130.
 1915. „ „ Allen. Journ. M. B. A., vol. x, p. 642.
 1916. „ „ McIntosh. Ann. Nat. Hist., ser. 8, vol. xvi, p. 20.
 1917. „ „ Rioja. Anél. Poliq. Cantáb., p. 62.

Habitat—First found in South Devon (Montagu); Falmouth; in a muddy tube in a chink of a rock near low water mark, St. Peter Port, Guernsey, and under a stone between tide marks, Herm (W. C. M.). Plymouth (Allen). Not uncommon on the southern shores, and represented in Leach's collection in the British Museum. Abroad it has been met with at Bréhat, Dinard (De St. Joseph); shores of Cantabria (Rioja).

In the living form the dorsal groove presents a white bar at the edge of the collar, and a brown fillet occurs at each side and passes under the large ventro-lateral brown flaps bordered with white (Plate CXIII, fig. 5), the dorsal edges of which are continuous with a slight ridge on each side of the anterior region, the ridge being above a deep furrow which leads from above downward to the mouth. Ventrally the deep purplish-brown collar with its border of pure white stretches continuously across till it passes in front of the lateral flap. Dorsally and ventrally the anterior region is somewhat paler than the rest, the lateral region, however, being slightly darker, as indeed it is all the way backward till near the tip of the tail. Ventrally the scutes are buff (pale brownish) and marked by the copragogue, which turns to the right at the posterior border of the anterior region and passes dorsally. In an example the segment in front ventrally was entire, but the next in front was split as if it had a copragogue of its own. Young forms are pale greenish, the branchiæ being pale, and only a little border of white and a few touches of brown are visible ventrally at the collar, which has a deep median fissure. Dorsally none of these hues are present, the rudimentary flaps being pale. The great development and pigmentation of these flaps is an adult feature.

When the branchiæ are removed from the cephalic plate, the dorsal groove abuts on two semicircles of firm chordoid tissue which pass downward to the sides of the mouth. From the groove a firm process of similar tissue passes straight downward and bifurcates after a short course, its summit giving origin to two short curved flaps, like a bifid epistome, overhanging the mouth, which appears as a triradiate fissure with two pouting membranous lobes inferiorly. By the sides of the dorsal groove are two thick, firm ridges, apparently fused with the basal chordoid semicircles supporting the branchiæ. From the outer base of each of these the collar arises by a thick circular flap, from which the large lateral division passes forward and downward to end in a smaller thick attachment at the side of the anterior process of the first scute (Plate CXIII, fig. 5). This lateral flap is slightly tinted in the preparations, but in the living form is of the same deep violet-brown bordered with white. Overlapping the ventral edge of this lamella is the ventral plate, which curves downward and

extends on each side of the middle line into a triangular reflected flap, the anterior surface of the whole being of a rich deep brownish purple bordered with white. If the base of the separated branchial system be examined, a facet marks the dorsal end of each of the semi-circles of firm tissue for attachment, and the facet fits on the chordoid pillars on each side of the dorsal furrow. The firm basal mass of each branchial fan is bridged on the ventral side of the facets by a narrow but firm band. From the ventral aspect (Plate CXIII, fig. 5, and Plate CXV, figs. 1—1b) the basal mass on each side curves forward and inward to end in a thick inrolled edge in the centre of the spire. In the middle line, and attached by its basal web to the bridge of connecting tissue on the one hand and the dorsal edge of the base of the fan on the other, is the tentacle on each side. These webs are of importance in directing currents, and the ventral surface is incurved. The tentacle is short, broad at the base and tapered distally. The exterior of its base is tinted brown, and a ridge, formed apparently by the prolongation backward of the thickened margin of the flap guarding the dorsal edge of the channel from the centre of the spire, keeps the base of the tentacle stiff. It strictly belongs to the branchial apparatus and separates with it. The mouth itself shows deeply folded walls ventro-laterally, viz. an inner or dorsal smaller fold, and a considerably larger fold or lamella running into the body-wall ventrally.

From the firm, muscular spiral base the branchial filaments pass forward to the number of forty-five to eighty on each side, the number apparently increasing with age. They are united at the base by a short web, and are comparatively long. Each filament has the camerated chordoid axis, which extends to the base of the terminal process, but does not seem to enter it, for only an opaque granular central region with a short web at each side is present. On the outer edge of many a pair of well-marked pigment-specks, and in some two or three, occur, but their position is irregular. Where three are present, the first is a short distance above the base, and the others at irregular distances. A considerable portion of the tip is always devoid of them. They are dense masses of blackish pigment apparently enclosed in some cases in a capsule. The pinnæ (barbules, De St. Joseph) are short, and form a dense double row along the inner edge of the filament, becoming shorter as they approach the tip, where they end abruptly (Plate CXXVIII, fig. 5e). Their colour is brownish violet. In young forms with twenty branchiæ in each fan, a pair of black ovoid eyes occurs on the dorsal filaments about a third from the end, whereas the specks are situated near the middle of the ventral filaments.

A section through the anterior region behind the origin of the branchiæ shows the great development of the chordoid supporting tissue (Plate CXXXVI, fig. 22), and the arrangement of the parts about the mouth.

The *body* is of moderate length for a *Sabella*, ranging from two inches to six or more (13 cm.—1 cm. broad, De St. Joseph), and the segments vary from eighty to ninety or more. It is rounded dorsally and flattened ventrally, the mid-ventral line being marked by the groove from the posterior edge of the anterior region to the tail. The body tapers from the posterior third (in spirit) to the tip of the tail, at which the anus is, whilst beneath the tip are two somewhat ovoid papillæ with pigment-dots. The anterior region has nine bristled segments, but the number, as De St. Joseph shows,¹ varies much, *e. g.* from five to eleven, and the numbers on the respective sides may differ. The setigerous processes are large,

¹ 'Ann. Sc. nat.,' 7^e sér., xvii, p. 288.

and have the form of short, blunt cones. The first segment is fused with the buccal, and bears the first bristle-tuft. In this (anterior) region the bristles are directed upward and backward as conspicuous tufts, whilst the rows of hooks stretch on rounded elevations between them and the ventral scutes. The segments are deeply cut ventrally in this as in the succeeding region. The first ventral scute has two lunate depressions upon which the ventral lappets of the collar apparently impinge, the glandular tissue having been absorbed or arrested in development on these areas. The next ten scutes in the example from Plymouth are undivided by the median line, though three show a white streak in the centre—two of these belonging to the posterior region. The scutes are continued to the posterior end as elongated plates on each side of the median groove.

The colour of the body is brownish violet (De St. Joseph), and there are frequently brownish spots on the anal segment, and in the posterior region between the bristles and the rows of hooks.

The bristles of the anterior region are characterised by their golden hue and their distinct separation into two groups—a longer dorsal row, the long axis of which is nearly horizontal or slightly oblique, and a mass of shorter bristles beneath them. The upper bristles (Plate CXXVIII, fig. 5) have very long, straight, striated shafts, tapering a little as they approach the tip, which is finely tapered, distinctly curved, serrated, and furnished with narrow wings, these indeed in some being indistinct. The bristles, moreover, show a gradation posteriorly where shorter forms with nearly straight tips and somewhat wider wings occur. The second series forms a dense brush considerably shorter than the foregoing, and, as in other species, the two groups are moved by separate muscles so that their special functions may be performed. The shafts of the longer bristles of this group are similar to those of the first series, but shorter and slightly stouter, and the shorter tapered tips have a trace of a curve, and wider wings, but soon a tendency to form a tip like a knife-blade, in which the wings are fused, is apparent, and by-and-by in the shorter bristles the translucent flattened tip is formed. This flattened blade varies in length and breadth as well as in curvature, but the majority of the bristles in these tufts are of this formation. The peculiar flattening of the tips, which are thinnest distally, gives great flexibility to the organs so that their function of smoothing and brushing is facilitated. All have strong, striated, golden shafts which gradually dilate from their translucent bases to the distal third, when gentle narrowing again occurs to the origin of the terminal blade. When softened and compressed in glycerine, the various stages in the transformation of a winged form, with an elongated tapering tip and with bold striæ on the wings, to a form in which the tip is broad, flattened and translucent with but a trace of minute striation, can be followed. It resembles a pointed scalpel, only a trace of a wing appearing toward the convex edge (Plate CXXVIII, fig. 5*a*), which is serrated, the lines sloping outward and upward. De St. Joseph counted sixty long bristles and two hundred shorter in the sixth segment of an example 13 cm. long.

With the change of feet in the second division of the body a reversion to the normal type of bristle takes place, the fascicles consisting of smaller, shorter bristles of nearly equal size with finely striated, straight shafts similar in formation to the preceding, but which have narrow wings—gradually disappearing on the delicately tapered tips, the minute serrations on the edges being continued far upward. These bristles are grouped in a tulip-like tuft.

In the posterior region the bristles form a cylindrical pencil, a slight swelling occurring distally where the wings project. Their tips are more finely tapered than in the first region, and there is a slight curvature at the commencement of the wings. The pencil springs from a distinct setigerous papilla. The bristles of the flattened caudal region again, while retaining as a group the form of a pencil, have the tips of the majority greatly elongated (Plate CXXVIII, fig. 5*b*), so that this region of the body is specially hirsute. No wings are visible in these much elongated forms, but in the shorter forms these are well marked and have serrated edges. The anterior hooks, which commence on the second bristled segment (Plate CXXVIII, fig. 5*d*), are situated on long, low flaps, eight in number, which stretch from the setigerous process almost to the ventral scute in each segment. They are in a single row, and are characterised by their somewhat long necks—a condition which may have misled Claparède to give them a long manubrium, from which the main fang arises at less than a right angle, and has eight or nine small teeth above it in lateral view. The prow is rounded and prominent, but the base is short, for it abruptly tapers to a blunt point posteriorly. A series of bold striæ occupy the central region from the crown to the base, into which they curve. Each hook is accompanied by a short bristle with a thick shaft, a slight narrowing of the neck, then an enlargement of the base of the flattened, tapered tip, which is bent backward at an angle, and, according to position, is either symmetrical or asymmetrical. De St. Joseph found no less than 108—140 hooks in a single row in the anterior region. The posterior hooks do not differ except in the length of neck, smaller size, and in the presence of short striæ on the neck at the base of the great fang. These may indicate a stage in the development of hook-like points on the region. De St. Joseph states these have smaller and shorter bases, and he gives the numbers in several examples.

Reproduction.—A fine example procured in July in a chink of the rocks at St. Peter port is a nearly ripe male.

A young example occurred in the fissure of the rock a few inches from the adult. When alive it appeared to be about half an inch in length. The anterior region has seven setigerous and six uncinigerous processes, whilst the posterior consists of about thirty-nine segments, the tip of the tail apparently being incomplete. Nine scutes are in front of those split by the mid-ventral line, instead of eleven in the adult, showing that whilst the two behind the anterior region are constant, the rest increase with age. The cephalic lamellæ and folds are similar. The branchial filaments are respectively eleven and twelve, and they have the beautiful white tints of the adult, and the same basal web. The ocular pigment-spots in the preparation, however, are few and minute, some in all probability having been bleached by the spirit. The structure of the anterior and posterior bristles and hooks at this stage corresponds with that of the adult.

In another young example found under a stone at St. Peter Port, Guernsey, and which was about three-quarters of an inch in length, the reflected lamellæ of the collar were of a rich reddish-brown colour. The anterior region consists of ten bristled segments and nine long scutes, and the region which follows appears to have more than thirty segments. The body is comparatively short, grooved on the dorsum for a short distance behind the fissure of the collar, and rounded behind the anterior groove. The ventral surface is slightly flattened, and marked by the median furrow from the tenth scute backward.

The *tube* of an adult measures fully nine inches in length, and is a little less than half an

inch in diameter. More than two-thirds of it is composed of a fairly firm, yet elastic, brownish secretion, with very little mud attached, though a small *Anomia* or two may be present externally. The basal region, which appears to be fixed, is more like the tube of *Sabella penicillus*, being coated with greyish mud, a few minute specks of calcareous matter (broken shells) and a small *Balanus*. The tough distal region of the tube is in places semi-transparent. In the young forms the tubes of two to three inches are composed throughout of secretion and mud as in *Sabella penicillus*.

This is one of the striking British species we owe to the persevering labours of Col. Montagu, who found it on an oyster-bed on the coast of Devon, and an excellent coloured figure, by his niece, Miss D'Orville, is given in the 'Linnean Transactions' (1804). De St. Joseph describes the tube as similar to that of *Sabella penicillus* and much longer than the inhabitant. The inferior extremity of the tube is thinner and more transparent, consisting only of the secretion of the annelid fixed to the stones amongst which it dwells. The young forms often attach their tubes to those of the adult.

Grube (1851) made two species of this form, as indicated under the synonyms.

H. Rathke, in his 'Fauna Norwegens' (1843), includes this species with a question, and so far as his figures of the hooks and bristles go, he has reason to be doubtful. The hooks especially diverge. Rathke's figures of these organs, however, are too elementary for accurate diagnosis.

Claparède (1868) appeared to consider, after Rathke, that *Bispira* had hooks with a long manubrium, by which he probably means the shaft. Such, however, is not the case.

Lo Bianco¹ (1893) describes a new species from Naples, which he terms *Bispira Mariæ*, but, so far as can be observed, there is little to distinguish it from the present form.

De St. Joseph (1894) found a parasitic Copepod, viz. *Bispirophilus tenax*, on the branchiæ. "The parasite is fixed by the second pair of antennæ."

Genus CLXVI.—SPIROGRAPHIS, Viviani, 1805.

1. SPIROGRAPHIS SPALLANZANI, Viviani, 1805. Plate CXXXIII, figs. 7—7c—bristles and hooks.

Though no British example of *Spirographis spallanzani*, Viviani, has been seen by the author, yet in all probability a further search in the Channel Islands and South coast of England will be successful. The specific characters, therefore, have been briefly entered, with one or two figures.

Specific Characters.—The cephalic region has the collar widely separated dorsally, two triangular flaps, much larger than in *Bispira*, occupying the intermediate region, and adherent to the branchial pillars. The collar passes ventrally, where it forms two lappets as in *Bispira* directed backward and separated by a median fissure. In front of these are the lower oral folds, coloured similarly, in the preparation, of a rich brown. In life the collar is dark violet, the ventral lobes white below, with white papillæ on the reflected edge. The lateral lobes are violet. The branchial filaments arise from stout pillars separated both dorsally and ventrally by a cleft, and ventrally the right² overlaps the left base, the grooves of both, however, trending to the mouth. The tentacles form short frilled flaps, best seen dorsally,

¹ 'Atti Accad. Sc. Nap.,' vol. v, p. 75, tav. i, fig. 2, and tav. iii, figs. 7 and 8.

² Claparède says either right or left.

and taper distally. They have a translucent skeletogenous support internally. The filaments are long and with a strong tendency to spiral coils (six and a half as a rule). They are coloured brown, white, violet, and orange—forming successive zones; sometimes uniformly coloured, or pale. The body is long, and slightly flattened both dorsally and ventrally, though less so than in *Bispira*, measures six to twelve inches, is of nearly equal diameter in the preparation till near the tail, where it is diminished to a blunt point. The segments are well marked, somewhat broader in front and narrower behind, where the segments are corrugated and marked by a median furrow. The thoracic region has eight segments, the dorsal bristles of opposite sides, as in its allies, approaching each other more closely. The copragogue passes dorsally behind the eighth bristle-tuft on the right. The colour of the body is dull brown on the ventral surface, greyish dorsally. A spot of white occurs at the ventral end of the thoracic tori, and at the dorsal end of the abdominal tori. The bristles are brownish by transmitted light, golden by reflected. The first tuft has more slender shafts, and tapering tips with narrow wings, the curve at the tip being slight, and the same type continues to the eighth. Posterior bristles in brush-like fascicles, with shorter tips and broader wings. Hooks typically Sabellid, the anterior considerably larger than the posterior. The serrations on the edge above the chief fang are very fine, the prow is rounded and the space above it larger, thus differing in the more elongated neck, the distinct serrations on the crown and the longer and bolder striæ of the body from those of *Bispira*. Moreover, the occurrence of the short bristles with the broad paddle-like tips in the thoracic tori is a feature of moment.

Tube greyish, covered with sand-particles.

SYNONYMS.

1558. *Pinceau de mer*, Rondeletius. Lib. ii des poissons, p. 76.
 1755. *Corallina tubularia melitensis*, Ellis. Corallines, p. 92, pl. xxxiii.
 1766. *Nereis lutaria*, Pallas. Misc. Zool., p. 116, Tab. x, fig. 1.
 1767. *Sabella penicillus*, Linnæus. Syst. Nat., Edit. xii, p. 1269.
 1802. „ „ Viviani. Journ. de Phys., ann. 1803, p. 321.
 1805. *Spirographis spallanzani*, idem. Phosphor. Mar., p. 14, pls. iv and v.
 1818. *Amphitrite ventilabrum*, Lamarck. Hist. Anim., t. v, p. 356.
 1820. *Sabella* „ Savigny. Syst. Annel., p. 81.
 „ „ *unispira*, idem. Ibid., p. 80.
 „ *Spirographis spallanzani*, Schweigger. Handbuch Nat., p. 600.
 1826. *Amphitrite ventilabrum*, Risso. Hist. Nat. Eur. Mérid., t. iv, p. 410.
 „ „ *Josephinæ*, idem. Ibid., t. iv, p. 410.
 1830. „ „ *penicillus*, Bosc. Hist. Nat. Vers., vol. iii (2nd edit.), p. 199.
 „ *Spirographis spallanzani*, Cuvier. Règne Anim., t. iii, p. 193.
 „ *Sabella unispira*, idem. Ibid., pl. iv, fig. 1.
 1838. ?*Amphitrite ventilabrum*, De Blainville. Dict. Sc. nat., art. vers, p. 434.
 „ „ *spallanzani*, idem. Ibid., p. 434, pl. ii, fig. 5.
 „ *Sabella unispira*, Grube. Anat. Kiemenwürmer, p. 24.
 1841. „ *ventilabrum*, Delle Chiaje. Descriz., t. iii, p. 71.
 1846. „ *Josephinæ*, Grube. Arch. f. Naturges., p. 53, Taf. ii, fig. 6.
 1851. „ *ventilabrum* and *spallanzani*, idem. Fam. Annel., p. 88.
 „ „ *unispira*, Williams. Rep. Brit. Assoc., p. 193, etc.
 1853. „ „ idem. Ann. Nat. Hist., 2nd ser., vol. xii, p. 395.

1864. *Spirographis spallanzani*, Grube. Insel Lussin., p. 30.
 1865. *Sabella unispira*, Johnston. Annel. Brit. Mus., p. 262.
 „ *Spirographis spallanzani*, De Quatrefages. Annel., t. ii, p. 427.
 „ „ *elegans*, idem. Ibid., t. ii, p. 430.
 „ „ *brevispira*, idem. Ibid., t. ii, p. 430.
 „ *Sabella ventilabrum*, idem. Ibid., t. ii, p. 554.
 „ ? *Spirographis longispira*, idem. Ibid., t. ii, p. 429.
 1868. „ *spallanzani*, Claparède. Annel. Nap., p. 415, pl. xxx, fig. 2.
 1870. „ „ idem. Ibid., Suppl., p. 136.
 „ *Sabella spallanzani*, Grube. Arch. f. Naturges., p. 339.
 1873. *Spirographis spallanzani*, Claparède. Recher. Annel. Sed., p. 10, pls. i and v.
 1875. „ „ Marion. Rev. des Sc. nat., iv, p. 474.
 „ *Sabella unispira*, Marion and Bobretzky. Ann. Sc. nat., 6^e sér., t. ii, p. 91.
 „ *Spirographis spallanzani*, Panceri. Atti Soc. Ital., vol. xviii, p. 533.
 1885. „ „ and *longispira*, Carus. Fauna Medit., i, p. 273.
 „ „ „ Pruvot. Arch. Zool. Expér., 2^e sér., t. iii, p. 345.
 1886. „ „ Jaquet. Mitt. Zool. Stat. Neap., Bd. vi, p. 359, pl. xxxi, figs. 67—70.
 1887. „ „ Meyer. Ibid., Bd. vii, p. 716, Taf. xxii, xxiii, etc.
 1888. „ „ idem. Ibid., Bd. vii, p. 478, pl. xxv, figs. 25—29.
 1890. „ „ Chiji. Organi excret. Serpul., p. 28, etc., pls. ii, iv, etc.
 1891. „ „ Soulier. Trav. Inst. Zool. Montpel., nouv. sér., Mém. 2, pp. 29—47,
 etc., pls. i—v, vii and x.
 1893. „ „ Lo Bianco. Atti Sc. Neap., 2^{me} sér., t. v, p. 73.
 1898. „ „ Soulier. Trav. Inst. Zool. Montpel., ii, pp. 343—346.
 „ „ De St. Joseph. Ann. Sc. nat., 8^e sér., t. v, p. 429.
 1899. „ „ Vaney et Conte. Comp. Rend. Soc. Biol. Paris, 16 Dec., p. 873.
 1901. „ „ Brunhiol. Comp. Rend. Acad. Paris, t. cxxxii, p. 1348.
 1902. „ „ Soulier. Trav. Inst. Zool. Montpel., sér. 2, Mém. 10, pp. 8—12,
 text-figs.
 1909. „ „ Fauvel. Ann. Sc. nat., 9^e sér., t. x, p. 210.
 1913. „ „ Ehlers. Deut. Sud-Polar Exped., p. 570.
 1917. „ „ Rioja. Anél. Poliq. Cantáb., p. 61.

Habitat.—Southern shores (Dr. Williams). Benham (Camb. Nat. Hist.) observes that it occurs off the Channel Islands, though it was not seen by the author when dredging there. Arnold Watson also states that he saw an example from the English shores.

Shores of France, St. Vaast-la-Hogue (Fauvel). Mediterranean (Risso, Verany, Delle Chiaje, Claparède, shores of Cantabria (Rioja). Azores (Ehlers).

This species has not been procured by the author in British waters, but others seem to have been more fortunate.

In his account of the nervous system of Sabellids, Pruvot (1885) describes the neural canals of this species as in the substance of the nerve-cords.

Genus CLXVII.—FABRICIA, *De Blainville*, 1828. AMPHICORA, *Ehrenberg*, 1836; *Leuckart and Claparède*. OTHONIA, *Johnston*, 1834; *Gosse*.

Cephalic region distinct; collar almost absent; branchial filaments few, bases free. Body with few segments, regions not distinct. Eyes on first segment and on last. Bristles

capillary with tapered tips and narrow wings. Hooks of two kinds, the anterior rostrate, with long, tapering and curved shafts, large flat crowns, a main fang and four teeth above it. The hooks of the last three segments are minute, have a broad base, long neck and long crown with a series of equal teeth. Social; in tubes of secretion and mud.

1. FABRICIA SABELLA, *Ehrenberg*, 1836. AMPHICORA FABRICIA, *O. F. Müller*, 1776. Plate CXIV, fig. 5—body; Plate CXXIX, figs. 7 and 7a—bristle and hook.

Specific Characters.—Branchial filaments three on each side, with long basal and shorter distal pinnæ so as to make, when folded, a fairly even series distally. No tentacles. Body of thirteen to fourteen segments and about 3—5 mm. in total length. Two eyes on first and last segments, or four anteriorly and two posteriorly. First two segments narrower. Rounded in preservation, often flattened in life; nearly cylindrical throughout the greater part, and only tapered posteriorly. Eleven pairs of bristle-bundles. Bristles simple, tapered at the tip, and with narrow wings. Hooks with long, tapering and curved shafts diminished inferiorly, and with a comparatively large, flat crown, a main fang and about four teeth above it. Minute hooks of the last three bristled segments wholly differ, having a broad base, long neck, and long crown with a series of equal teeth.

Colour of the body reddish brown, or dull brown. Social; in tubes of secretion and mud.

SYNONYMS.

- ✓ 1776. *Tubularia Fabricia*, *O. F. Müller*. Zool. Danic. Prodr., n. 3066, p. 254.
 1780. „ „ *Fabricius*. Fauna Grönl., p. 440.
 1828. *Fabricia stellaris*, *Blainville*. Dict. Sc. nat., t. lvii, p. 439.
 ✓ 1835. *Othonia Fabricii*, *Johnston*. Loud. Mag. Nat. Hist., viii, p. 181, fig. 19.
 1836. *Amphicora sabella*, *Ehrenberg*. Mitth. Ges. Nat. Freunde in Berlin, 1836, pp. 2, 4.
 1837. *Nais equisetina*, *Dugès*. Ann. Sc. nat., 2^e sér., t. viii, p. 34, pl. i, fig. 24.
 1844. *Amphicora sabella*, *Ersted*. Region. Mar., p. 68.
 ✓ 1845. *Othonia Fabricii*, *Johnston*. Ann. Nat. Hist., xvi, p. 448.
 ✓ 1847. *Fabricia quadripunctata*, *Frey and Leuckart*. Beiträge, p. 157.
 ✓ 1848. *Amphicora sabella*, *E. O. Schmidt*. Neue Beitr. Naturgesch. Würmer, p. 21, Tab. ii.
 ✓ 1849. „ *affinis*, *Leuckart*. Arch. f. Naturges., Bd. xv, p. 193.
 ✗ 1851. *Fabricia sabella*, *Grube*. Fam. Annel., p. 95.
 1853. „ *Dalyell*. Pow. Creat., vol. ii, p. 248, pl. xxxi, figs. 10 and 11.
 ✓ 1855. *Othonia Fabricii*, *Gosse*. Ann. Nat. Hist., 2 ser., xvi, p. 33, Tab. iv, fig. 22.
 ✓ 1861. *Fabricia sabella*, *Claparède*. Recher. Annél., Turbell., Hébrid., p. 50, pl. iv, figs. 11—15.
 ✓ 1865. *Othonia Fabricii*, *Johnston*. Cat. Worms Brit. Mus., p. 274.
 „ *Fabricia amphicora*, *De Quatrefages*. Annel., ii, p. 464.
 „ „ *quadripunctata*, *Mecznikow*. Zeitschr. f. wiss. Zool., xv, p. 328, pl. xxiv, figs. 1—4.
 ✗ 1867. *Amphicora Fabricia*, *Malmgren*. Annul. Polych., p. 117.
 „ *Fabricia quadripunctata*, *Marcusen*. Arch. f. Naturges., p. 358.
 ✗ 1868. *Fabricia sabella*, *Claparède*. Annél. Nap., p. 411.
 1874. *Amphicora Fabricii*, *McIntosh*. Ann. Nat. Hist., ser. 4, vol. xiv, p. 206.
 „ „ „ *Malm*. Annel. Göteb., p. 102.
 1875. „ „ *McIntosh*. Invert. and Fishes St. Andrews, p. 131.
 „ *Fabricia sabella*, *Panceri*. Atti Soc. Ital., vol. xviii, p. 233.

1879. *Amphicora Fabricia*, Tauber. Annul. Danica, p. 138.
 1881. *Fabricia sabella*, Langerhans. Canar. Annel., Nova Acta Leop. Car. Akad., xlii, p. 119, pl. v, fig. 28.
 1883. *Amphicora Fabricia*, Levinsen. Vidensk. Medell., p. 185.
 1884. *Fabricia sabella*, Langerhaus. Zeitschr. f. wiss. Zool., Bd. xl, p. 271.
 „ *Othonia Fabricii*, Webster and Benedict. Rep. Com. F. and F. U.S.A., for 1881, p. 736.
 1885. *Fabricia sabella*, Carus. Fauna Medit., i, p. 273.
 1887. „ „ Meyer. Mitt. Zool. St. Neap., Bd. vii, p. 721, and Bd. viii, pp. 479, 485, 530, 536, 547, 561, 573.
 „ *Othonia fabricii*, Webster. U.S. Com. F. and F., p. 750.
 1888. *Amphicora Fabricia*, Cunningham and Ramage. Trans. Roy. Soc. Edin., vol. xxxiii, p. 671.
 1891. „ „ Hornell. Trans. Biol. Soc. Liverp., vol. v, p. 263.
 1893. *Fabricia sabella*, Lo Bianco. Atti Accad. Sc. Nap., 2^e sér., v, No. 11, p. 76.
 „ *Othonia* „ Watson. Sheffield Philos. Soc., p. 2.
 1894. *Fabricia* „ De St. Joseph. Ann. Sc. nat., 7^e sér., t. xvii, p. 319, pl. xii, fig. 347.
 „ *Amphicora Fabricia*, Bidentkap. Christ. Vid.-selsk. Forhandl., p. 131.
 1896. *Sabella Fabricii*, Appellöf. Berg. Mus. Aarb., xiii, p. 12.
 1897. *Amphicora Fabricia*, Michaelsen. Polych. deutsch. Meere., p. 178.
 1910. *Fabricia sabella*, Southern. Proc. Roy. Irish Acad., vol. xxviii, p. 242.
 „ „ „ Elwes. Journ. M. B. A., vol. ix, p. 65.
 „ *Amphicora fabricii*, Skorikow. St. Petersburg. Mus. Ann., xv, p. 233.
 1913. „ *Fabricia*, Giard. Œuvres Diverses, p. 57.
 „ *Fabricia sabella*, Ehlers. Deut. Sud.-Pol. Exped., p. 577.
 1914. „ „ Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 140.
 1915. „ „ idem. Irish Sc. Invest., No. 3, p. 49.
 „ „ „ Allen. Journ. M. B. A., vol. x, p. 643.
 1916. *Amphicora Fabricia*, McIntosh. Ann. Nat. Hist., ser. 8, vol. xvi, p. 25.
 1920. „ „ Eliason. Polych. Öresund., p. 77.

Habitat.—Abundant near low water-mark at the East Rocks, St. Andrews, the tube adhering to red Ascidians (*Styelopsis grossularia*). In swarms in certain muddy parts near low water, St. Andrews (E. M.); between tide marks, Lochmaddy; in midwater net near the bottom; off Isle of Man; under scales of *Harmothoe imbricata*, St. Andrews, probably accidentally (E. M.); between tide marks, White Cliffe Bay, Isle of Wight (A. and R. M.); Granton (Dr. G. S. Brady); Skye, etc. (Claparède); Lambay Shore, Dublin Bay and West Coast of Ireland (Southern); Torquay (Elwes); Roots of Fuci growing on shale, Granton (Cunningham and Ramage).

Abroad it is found in Greenland, Finmark, Iceland (Leuckart), and, generally speaking, in North European waters. Heligoland (Ehrenberg); Thorshaven (Schmidt); Mediterranean, Black Sea, Atlantic; Madeira (Langerhans); Spitzbergen (Meyer); Western Baltic and Finmark (Norman); Black Sea; E. N. America.

The cephalic region has a projecting, broadly conical ventral median process, and dorsally the margin presents a median notch behind a small conical process connected with the mouth. There is thus an indication of a collar, and it and the next segment are narrower than those which succeed. Two eyes are situated a little behind the anterior border, and beneath are two pale red masses (ganglia). In front of these, at the base of the tentacles, are two deep

red spots (hearts) apparently in connection with the blood-vessels. These hearts, according to Arnold Watson, pulsated from twenty-four to thirty-eight times per minute. The branchiæ, which have no visible web at the base, are three in number on each side, the dense series of pinnæ arising from these main stems on each side, and all are quite pale. The pinnæ are longer at the base of the filaments and shorter toward the tip, so that the general effect of the arrangement in closure of the fan is to have a fairly even series distally. They are ciliated internally. At their base are two short and nearly cylindrical tentacles, ciliated like the branchiæ. A single vessel occurs in each pinna in the line of the cilia, and the surface has numerous palpocils. Moreover, two vascular enlargements occur at the base of the branchiæ, which have been termed hearts. Mr. Watson states that the tentacles retain the material collected by the branchial fans and guide it to the mouth, whilst with their outer surface they expel refuse which reaches them, by the dorsal groove, from the anus. The tips of the branchial filaments are not ciliated in the older specimens, but apparently

FIG. 156.

FIG. 155.

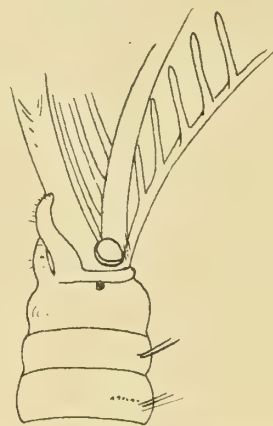


FIG. 155.—View of the ventral lip of *Fabricia sabella* in a young example, in which the snout is broader.
After Arnold Watson. Enlarged.

FIG. 156.—Outer aspect of left branchial tuft and lip of *Fabricia sabella*. After Arnold Watson.

act as tentacles, and have tactile hairs. The spatulate lip serves to guide food into the mouth by the inner ciliated surface, and to build with its outer ciliated surface. It grasps material firmly, even near the tip, by its outer surface, which is closely applied to it, but whether by suction or otherwise is not evident (Arnold Watson). The ridge on the second segment does not appear to take any part in grasping material.

In a young example the same indefatigable observer found two long straight, smooth filaments, which reached the tip of the branchial fan, and arising from each side of the mouth at the base of the ordinary filament with the swelling there. The front lip is more rectangular at the tip than in the adult, and the lateral extensions from it—terminating dorsally in slightly projecting lobes (between which the small dorsal lip enters to separate the branchial plumes)—give the semblance of a collar to the region.

The *body* is rather more than an eighth of an inch (1—2 mm.—De St. Joseph) in length, cylindrical throughout the greater part of its extent, then tapered toward the tail. The segments are thirteen in all, seven of which pertain to the anterior and six to the posterior region. It is more or less rounded in the preparations, but in life it is often flattened. The first or buccal segment has two black eyes. The general colour is brownish or straw colour.

Posteriorly it terminates in a rounded pygidium which has two eye-specks. The alimentary canal is straw-yellow, is wide anteriorly, bulges here and there in its course, and then narrows posteriorly. On each side of it is a red blood-channel. The body-cavity is filled with a vast number of granular cells about $\frac{1}{900}$ of an inch in diameter. In front of the eyes at the base of the branchial lobes is a blood-sinus (branchial heart of Ehrenberg and Claparède), and Langerhans counted twenty-five pulsations per minute. The blood is stated to be red by Mecznikow and Claparède, whereas De St. Joseph says it is green.

The first segment is devoid of bristles, but the second has a tuft on each side about the middle of the segment. These bristles (Plate CXXVIII, fig. 7) are few, simple and translucent, with straight shafts, finely tapered tips and narrow wings. The tip in some views is bent at a slight angle to the shaft. Eleven segments are provided with them, the first and last having none. As usual in the family, the posterior bristles have the longest and most finely tapered tips. The minute anterior hooks (Plate CXXVIII, fig. 7a) are about six in number in each segment, have a comparatively large head, a constriction at the neck, then a well marked shoulder, after which the long curved shaft tapers inferiorly. The main fang is large, and the crown is flat, with about four teeth. The organ is a miniature representative of that of *Chone*.

The last three bristled segments have instead of the long hooks in front peculiar forms (Plate CXXVIII, fig. 7b), the posterior outline being incurved and the anterior slightly convex, whilst the crown is long and minutely toothed, no differentiation occurring between the lowest and the adjoining teeth. The base enlarges inferiorly, and is occasionally split, apparently from the pressure used in preparing.

Reproduction.—The sexes are separate. In August the males in the Gouliot caves of Sark had the coelom filled with nearly ripe sperms.

Mecznikow (1865) describes and figures in the fifth segment of a ripe male two ducts which he terms vasa deferentia, apparently leading from the coelom to the exterior. These in the female were smaller. In connection with the circulation he figures a branchial heart on each side anteriorly, the single dorsal of the region splitting into a trunk to each anteriorly, whilst after a brief course it divides into two dorsal trunks. The ventral is single, the dorsals looping at the tail to join it. In the middle of the body it is lacunar (the author probably referring to the alimentary sinus). Throughout the body a branch in each segment connects the main trunks. Two segmental organs occur in the anterior region, and he mentions that Leydig and Leuckart thought them connected with respiration.

Claparède describes the male organs as in pairs from the third to the ninth segments. De St. Joseph (1894) found a young example 0.74 mm. in length with large black anterior eyes, and two on the anal segment. The head is rounded. A single large branchia is present with rudiments of ciliated barbules.

Habits.—When placed in a vessel, it crawls about with the tail first, the branchial fan being drawn together and dragged behind.

Mr. Arnold Watson notes that the annelid sometimes leaves its tube and burrows tail-first through the surrounding soft mud. The building of its tube is done by means of the large triangular under lip beset with long, powerful cilia which are under control. The annelid stretches its body well out of the tube when anxious to grasp certain particles—even on the tube of another, and appears to take a firm grip of the particle. Having secured

it, the annelid withdraws itself into its tube until the lower lip is on a level with the edge, and then by again setting the cilia in motion it releases the particles (Watson).

Dugés (1837) figures the annelid (his *Nais equisetina*) inverted, the tail with its eyes being uppermost, and the cephalic filaments forming the posterior end, and his description corresponds. He probably observed it moving tail first.

Grube thought there was no inversion of bristles and hooks in the posterior region, but Claparède pointed out that it agreed with other Sabellids in this respect.

Claparède (1868) observes that Marcusen, finding this form at Odessa, and unaware of its presence in the Mediterranean, erroneously supposed that the fauna of the Black Sea approached that of the North Sea rather than the Mediterranean.

Genus CLXVIII.—ORIA, *De Quatrefages*, 1865.

Amphicorina, Claparède, non De Quatrefages.

Oridia,¹ Rioja, 1917.

Cephalic region with a slight ventral collar passing downward from each side of the dorsum; a pair of tentacles. Branchiæ few, five pairs; pinnules alternate. Body of few segments, ventral collar on first segment. Eyes on the caudal segment. Bristles winged anteriorly, devoid of wings posteriorly. Crotchets of the anterior region uniform; avicular hooks posteriorly.

1. ORIA ARMANDI, *Claparède*, 1864. Plate CXV, fig. 3—body; Plate CXXIX, figs. 5—5c —bristles and hooks.

Specific Characters.—Cephalic region with a conical ventral process; a slight and entire rim running from each side of the dorsal fissure. Branchial plumes five on each side. Body of sixteen segments, the first and last unarmed, but with a pair of eye-specks on each. Two otocysts in second segment. Anterior region of eight bristled segments; posterior of six. Body tapered a little posteriorly to end in a bluntly conical pygidium. Colour reddish green. Anterior bristles stouter than in *Amphicora fabricia*, with translucent, straight shafts, short tips and distinct wings. Posterior bristles long, hair-like and devoid of wings. Anterior hooks with long curved shafts, distinct shoulder and neck, stout, sharp main fang, and a moderately high crown, with two to three prominent teeth in lateral view above it. Posterior hooks short, with a long and minutely serrated anterior face above the main fang; a short, sharp, curved prow, and a short, broad base, with a convex inferior margin.

SYNONYMS.

1864. *Fabricia* (*Amphicorina*) *Armandi*, Claparède. *Glanures Zoot.*, p. 36, pl. iii, fig. 2.

1865. *Oria Armandi*, De Quatrefages. *Annel.*, ii, p. 462.

1868. „ „ Claparède. *Annél. Nap.*, p. 413.

1872. „ „ Marion. *Compt. rend.*, t. lxxiv, p. 1254.

¹ *Oria* was given by Hübner in 1816 for one of the Lepidoptera, whilst Robineau-Devoidy bestowed the same title on one of the Diptera.

1875. *Oria Armandi*, Panceri. Atti Soc. Ital., vol. xviii, p. 533.
 „ „ „ Marion and Bobretzky. Ann. Sc. nat., 6^e sér., t. ii, p. 90.
 1880. „ „ Langerhans. Zeitschr. f. wiss. Zool., xxxiv, p. 116, pl. v, fig. 30.
 1885. „ „ Carus. Fauna Medit., i, p. 273.
 1894. „ „ De St. Joseph. Ann. Sc. nat., 7^e sér., t. xvii, p. 321, pl. xii, fig. 348.
 1910. „ „ Elwes. Journ. M. B. A., vol. ix, p. 65.
 1914. „ „ Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 141.
 1915. „ „ Allen. Journ. M. B. A., vol. x, p. 643.
 „ „ „ Southern. Irish Sc. Invest., No. 3, p. 49.
 1916. „ „ McIntosh. Ann. Nat. Hist., ser. 8, vol. xvi, p. 26.
 1917. *Oridia* „ Rioja. Anél. Poliq. Cantáb., p. 73.

Habitat.—Not uncommon amongst the growths on *Balani* in the Gouliot Caves, Sark; Torquay in rock pools, and Newquay, Cornwall (Elwes); Blacksod and Clew Bays (Southern).

Elsewhere it occurs amongst *Rytiplea pinastroides* on the Coast of Dinard (De St. Joseph); the Mediterranean (Claparède, Panceri, Marion and Bobretzky); Atlantic; Madeira (Langerhans); Shores of Cantabria (Rioja).

Claparède (1864) describes a ventral *cephalic* collar in this species, apparently as distinguished from *Amphicora fabricia*, but so far as observed in the spirit-preparations there is not much difference in this respect—both presenting a conical ventral prolongation, and a narrow rim to the dorsal fissure. Claparède states that below the collar is a row of vibratile cilia. Immediately in front of the termination of the collar on the latero-dorsal region is an eye-speck on each side. The second segment bears a statocyst on each side, viz. a capsule with a statolith. The branchiæ are similar in general appearance, in two groups of five (Claparède). They are ciliated internally and have palpocils externally. The first ventral branchia is reduced to a simple filament without pinnæ. A single vessel occurs in each filament, and it ends blindly where the cilia cease.

The *body* (Plate CXV, fig. 3) of the examples from Sark is not larger than that of *Amphicora fabricia* from St. Andrews, the advantage in size indeed being with the northern form, which is also more translucent. The eyes had disappeared in the preparations (after forty-two years), and yet, as Claparède shows, those of *A. fabricia* are permanent in spirit. The number of segments is at once diagnostic, for *Oria Armandi* has fourteen bristled segments besides the first and last. Claparède, however, gives nineteen to twenty segments, though he found a ripe female with fewer than twelve segments. The first segment is achetous. At the tenth segment the bristles change to the ventral border and the shape alters.

The digestive system has a cylindrical colourless œsophagus, and from the third segment the gastro-intestinal canal proceeds backward as a brownish, wide tube. A blood-vessel runs on each side of the canal with a transverse branch in each segment; indeed, the gut is surrounded by a vascular rete (Claparède). In the seventh segment a pair of folded tubular organs (segmental ?) occur.

Fourteen pairs of bristle-bundles characterise those from Sark. The anterior bristles (Plate CXXIX, figs. 5 and 5') have stouter shafts than those of *Amphicora fabricia*, and the tapering tip is shorter, and has wider wings. Eight pairs belong to the anterior and six to the posterior region, the latter (Plate CXXIX, fig. 5a) being distinguished by their slenderness and the tenuity of their hair-like tips, as well as by the absence of wings. Moreover,

they are generally directed forward, with a slight curvature, whilst the anterior bristles are directed backward. The anterior hooks (Plate CXXIX, fig. 5b) have a similar shape to those of *Amphicora fabricia*, that is, have a curved shaft which tapers inferiorly, a shoulder, above which is a somewhat narrower neck surmounted by a strong, sharp main fang coming off at less than a right angle to the throat, and with two or three strong teeth above it, the crown being on the whole more elevated than in *A. fabricia*. The neck of the hook is also slightly bent backward. The posterior hooks, which, as in *Amphicora fabricia*, occur in the last three bristled segments, differ, as Claparède observed, from those of the species just mentioned in their shorter form (Plate CXXIX, fig. 5c), for the basal region is truncated, and the posterior outline short and concave, the conspicuous part of the hook being the long anterior face and crown—occupied by a small, sharp main fang and numerous minute teeth above it. The anterior outline below the main fang bounds a small bay, the prow bending up to circumscribe it. The inferior outline is convex.

The statocysts in this species belong to the second group of Fauvel,¹ viz., to the closed series, in which the statoliths are formed by concentric layers of secretion in the organ.

Reproduction.—Marion (1872) describes the reproductive elements in each sex as developing in hyaline investments on vascular tufts in each segment.

Mature specimens were found by Southern in September in Blacksod Bay, Ireland.

Genus CLXIX.—AMPHIGLENA, Claparède, 1864.

Eyes on the first (achetous) segment and on the pygidium. Branchiæ similar to those of other Sabellids and more numerous than in *Oria*; no collar. Dorsal bristles of two kinds on the anterior (thoracic) region, viz. those with elongated tips and narrow wings and those with short tips and broad wings (spatulate). Anterior hooks avicular, accompanied by "flag" bristles; posterior hooks also avicular. Hermaphrodite.

1. AMPHIGLENA MEDITERRANEA, Leydig, 1851. Plate CXIII A, fig. 4—ventral, and CXV, fig. 4—dorsal view of body; Plate CXXXI, figs. 4—4f—bristles and hooks.

Specific Characters.—Cephalic region with ten to thirteen branchiæ, each having a double row of ciliated barbules about thirty in number, shorter at the base and tip than in the middle, the tip ending in a long and slightly tapered process with a narrow web at the base. Body about 8 mm. in length, of twenty-nine to thirty-three segments, usually little tapered anteriorly, but more so posteriorly, ending in a bluntly conical or rounded pygidium which bears four to six pairs of eyes. First achetous segment has four eyes. Pair of spherical statocysts in the second segment, and two or three minute winged bristles dorsally. The next seven segments have dorsal tufts of bristles. Anterior bristles of two kinds, the upper or dorsal series with narrow wings, the lower with spatulate tips (from the broad wings), the ends being hair-like. Avicular anterior hooks commence on the second bristled segment, and have a long main fang with three or four spikes in lateral view above it; posterior outline much curved, and the posterior process long. A

¹ 'Comp. Rend. Acad. Sc. Paris,' December 29th, 1902.

series of minute spatulate bristles accompany them. Posterior hooks with more numerous spikes above the main fang, and the posterior process is shorter. Hermaphrodite and tubicolar.

De Quatrefages thought that the type of circulation in this group was degraded, for he could make out no vessel except in the vicinity of the branchiæ. The lining membrane of the cœlom, however, seemed to be detached and to contain the blood under it, and so with other tissues, the blood thus bathing them. This has not been verified.

SYNONYMS.

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|-------|---------------------------------|------------|--|
| 1851. | <i>Amphicora mediterranea</i> , | Leydig. | Zeitschr. f. wiss. Zool., Bd. iii, p. 328, pl. ix, figs. 6—7. |
| 1864. | <i>Fabricia Armandi</i> , | Claparède. | Glanures, pp. 36 and 128, pl. iii, fig. 1. |
| 1868. | <i>Amphicora mediterranea</i> , | idem. | Annél. Nap., p. 414, pl. xii, fig. 6. |
| 1875. | „ | „ | Marion et Bobretzky. Ann. Sc. nat., 6 ^e sér., t. ii, p. 91. |
| „ | <i>Amphiglana</i> | „ | Panceri. Atti Soc. Ital., vol. xviii, p. 533. |
| 1890. | „ | „ | Chigi. Organi excretori d. Serpuli, Foligno, pp. 51 and 77 (<i>fide auct.</i>). |
| 1893. | „ | „ | Lo Bianco. Atti R. Accad. Sc. Nap., vol. v, No. 11, p. 81. |
| 1894. | <i>Amphicora</i> | „ | De St. Joseph. Ann. Sc. nat., 7 ^e sér., t. xvii, p. 307, pl. xi, figs. 315—322. |
| 1906. | <i>Amphiglana</i> | „ | idem. Ibid., 9 ^e sér., t. iii, p. 241. |
| 1909. | „ | „ | Lo Bianco. Mitt. Zool. St. Neap., Bd. xix, p. 576. |
| „ | „ | „ | Fauvel. Bull. Inst. Oceanogr., No. 142, p. 44. |
| „ | „ | „ | idem. Ann. Sc. nat., 9 ^e sér., t. x, p. 210. |
| 1910. | „ | „ | Elwes. Journ. M. B. A., vol. ix, p. 65. |
| 1911. | „ | „ | Riddell. Proc. Liverp. Biol. Assoc., vol. xxv, p. 65. |
| 1913. | „ | „ | Ehlers. Deut. Südpol. Exped., p. 576. |
| 1914. | „ | „ | Fauvel. Campag. Scient. Monaco, xlv, p. 317. |
| 1915. | „ | „ | Allen. Journ. M. B. A., vol. x, p. 643. |
| 1916. | „ | „ | McIntosh. Ann. Nat. Hist., ser. 8, vol. xvi, p. 28. |
| 1917. | „ | „ | Rioja. Anél. Poliq. Cantáb., p. 69. |

Habitat.—Hope's Nose, Torquay, between tide-marks (Major Elwes); Plymouth (Dr. Allen).

Abroad it occurs in the Mediterranean; shores of Cantabria (Rioja), Atlantic; Dinard, France, and Cannes in *Lithothamnion* (De St. Joseph); Fayal and Monaco (Fauvel); St. Vaast-la-Hougue (Fauvel); Antarctic Seas (Ehlers); Persian Gulf.

The *cephalic* region bears ten branchiæ, each pinnate with a double row of barbules, the whole forming, in the preserved examples, a tuft about one-third the length of the body. Each filament, according to De St. Joseph, consists of a double row of “cellules cartilagineuses,” whereas the barbules have only a single row. The number of ciliated barbules appears to be about thirty, and they are shorter at the base and the tip than in the middle. The tip of the filament ends in a long and slightly tapered process with a narrow web at the base, and it has palpcils. Each branchial filament has a single vessel (Claparède). Besides the two ciliated palps mentioned by Claparède, De St. Joseph, after Claparède, shows a coiled process on each side—filled with brown pigment-granules, which, after Meyer, he considers to be a fold of the upper lip—forming a superior lateral chamber on each side.

The *body* (Plate CXV, fig. 4) is about 8 mm. in length, but some may reach 18 mm.

(Claparède), usually little tapered anteriorly, but distinctly so posteriorly, and ends in a bluntly conical or rounded pygidium, which bears four to six pairs of eyes. The segments vary from twenty-nine to thirty-three. A pair of spherical statocysts, as mentioned by Claparède, exist in the second segment. They are ciliated internally and have statoliths. Claparède describes a dilatation of the oesophagus in the fourth segment. The circulatory system, according to the same author, consists of a contractile ventral vessel and two lateral trunks applied to the alimentary canal, but he could not detect the cæcal branches ordinarily seen in Sabellids.

The first achetous segment bears four eyes (in two pairs); and the second segment has two statocysts having a number of statoliths, besides two or three minute-winged bristles dorsally, and the next seven segments have dorsal tufts of bristles, the upper having narrower wings, the lower spatulate from the breadth of the wings, gradations occurring between the two, showing a long hair-like continuation of the shaft as well as the broad wings. The dorsal forms (Plate CXXXI, figs. 4 and 4*a*) have a long shaft slightly curved backward toward the tip, which is finely tapered and furnished with wings of moderate breadth, which insensibly disappear below the hair-like tip. The inferior bristles of the same group—that is, those next the inferior hook-row—have wings so short and broad as to make the tip spatulate, and often with a slender hair-like continuation in the middle (Plate CXXXI, fig. 4*b*). Both types of bristles are frequent in the Sabellids. Similar bristles occur on the anterior “abdominal” region, but the last six at least are very long, attenuate, and project prominently outward, whilst scarcely a trace of a wing is visible even in the most anterior long tuft.

A series of minute bristles (Plate CXXXI, figs. 4*c* and 4*d*) with the spatulate tip bent at an angle accompany the anterior hooks, which commence on the second bristled segment. These occasionally project beyond the line of the main fangs of the hooks *in situ*. The hooks, of which there are about eleven in each row (Plate CXXXI, fig. 4*e*) have a remarkably long main fang with three or four spines in lateral view above it, making a high crown; the posterior outline is much curved and runs to the basal process, whilst the gulf between the chief fang and the prow is rather narrow. The posterior process is comparatively long. In the posterior hooks (Plate CXXX, fig. 4*f*) the spikes above the main fang are more numerous as well as more evident. The chief fang itself is powerful and slightly curved. The gulf anteriorly is as well marked as in the thoracic hooks, but the prow is proportionally broader, more blunt, and the posterior process considerably smaller and shorter. The number of the hooks anteriorly is similar to that found in the “thoracic” region, but posteriorly they diminish, so that in the antepenultimate row there may be only one. The change in the setigerous and uncinigerous processes occurs at the tenth segment, the posterior region having the hooks dorsal and the bristles ventral.

Reproduction.—Claparède first noticed the hermaphrodite condition of this species, ova and sperms occurring in the coelom, and he gave an account with sizes of both ova and sperms. He describes the dorsal pore by which the common duct of the ciliated segmental organs opens behind the branchiæ. Lo Bianco (1909) gives February to May as the period of sexual maturity at Naples. De St. Joseph also alludes to the large red eggs (0.27 mm. in diam.) in an example of forty segments, occupying, to the number of sixteen, the first ten abdominal segments, and the sperms the last nineteen. He figures (1906) the sperms as short bodies with an elliptical head.

Lo Bianco¹ (1893) mentions that *Amphiglena*, like certain species of *Myxicola*, abandons its temporary membranous tube after a longer or shorter period.

Nusbaum² (1905) gives an elaborate account of the regeneration of the anterior and posterior ends and the various tissues in this species—which he examined at Naples along with *Nerine cirratulus*. The process of regeneration of the branchiæ resembles that of the development of the organs in the young form.

Genus CLXX.—DASYCHONE,³ Sars, 1861.

? *Clymeneis*, H. Rathke, 1842; *Branchiomma* ?, Köl liker, 1858.

Cephalic region with a well-developed though rather thin collar, which is folded and split dorsally, and has a shallow notch on each side ventrally, the central region showing a thin reflected ventral lamella of a triangular shape on each side of the middle line, somewhat like that of *Sabella penicillus*. Body rather short, slightly rounded dorsally, flattened ventrally, and consisting of two regions. It tapers somewhat abruptly to a short tail with a median bilobed anus. No anterior dorsal furrow, but ventrally it commences on the left in the fissure between the eighth and ninth bristled segments, reaches the middle line at the posterior part of the ninth and continues to the anus. A black pigment spot between the setigerous process and the row of hooks throughout. Branchiæ forming a subconvolute fan on each side, the tips of the organs ending in a delicate filament of moderate length, bordered by a web at the base, and having a series of external appendages, and often pairs of ocular specks. Tentacles two; a third or a fourth the length of the branchiæ. Anterior region of eight bristled segments (the first bristles being on the second) with the accompanying uncinigerous rows ventrally; posterior region with the bristles ventral and the hooks dorsal. Bristles of two kinds, a longer dorsal series with more attenuate winged tips, and a ventral series with broader wings. Tubicolar.

1. DASYCHONE ARGUS, Sars, 1861. Plate CXII, fig. 6—body; Plate CXIII A, fig. 5—pale variety; Plate CXX, fig. 14—ventral view of the anterior region; Plate CXXI, figs. 1—1*d*—body, branchia, ova; Plate CXXIX, figs. 1—1*f*—bristles and hooks.

Specific Characters.—Cephalic plate (on removal of the branchiæ) shows on the truncated surface, at the dorsal inflection, two small folds from which a pear-shaped area passes ventrally to end in the oral ridge, the margin being formed by the collar, which has a lateral notch separating the reflected and somewhat triangular ventral lamellæ from the rest of the rim whilst a wider gap in the middle separates them from each other. The individual elements of the fused bases of the twelve to eighteen or more branchiæ are marked by a reddish pigment-speck interfilamentar in position. From each half of the base (semicircle) the finely coloured filaments project freely, and end in short processes, at the base of which the pinnæ somewhat suddenly cease. Along the outer edge of each filament a series

¹ 'Atti Accad. Sci. Fisiche e Mat.,' vol. v, p. 2 (sep. copy).

² 'Zeitschr. f. wiss. Zool.,' Bd. lxxix, p. 222, taf. xiii—xvi, and text-figs.

³ *δαρυς*, hairy, and *χόανη*, funnel.

(about eighteen) of clavate processes are attached in pairs, and a pigment-spot occurs at each side just beyond the attachment. The colour of the branchiæ varies from pale green to dull orange with a tint of green, or dull purplish-red spotted with white, and several of the clavate processes are also white. Others have brownish-purple branchiæ. Body moderately elongated (1—2 inches), and having fifty-eight to sixty-six segments, rounded dorsally and devoid of an anterior groove, slightly flattened ventrally, and with a median groove from the posterior border of the ninth segment to the terminal anus, which has a papilla on each side. Colour madder brown or dull red with white specks dorsally and ventrally, or dull orange with only a few whitish grains on the collar; or light orange, the lobes of the collar being speckled with minute dots of white; two white papillæ occur at the anus, and a white patch in front of it. A bold dark brown speck is situated at the ventral edge of each setigerous process in the anterior region, the uncinigerous ridge commencing behind it. In the second region the speck is placed rather behind the setigerous process and at the commencement of the uncinigerous row. Typical anterior bristles in two series, an upper with short, tapering, winged tips and more elongated striated shafts, which slightly taper toward the wings and again toward the insertion. Those next have somewhat broader wings which are striated, and serrated at the edges. Posterior bristles in small tufts, the upper with much elongated tips and indistinct wings, whilst the lower have distinct and wider wings, though the tips are attenuate. Anterior hooks (which commence on the second bristled segment) avicular with the posterior outline convex and the anterior concave, the main fang leaving the throat at a little less than a right angle, and a series of small teeth occur on the crown above it. Prow convex, and the basal process strap-like and usually bent downward posteriorly. The posterior hooks are slightly smaller but their outline differs little. Tube composed of tough secretion more or less coated with mud, and sometimes fragments of shells are used for strengthening it.

SYNONYMS.

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 1803. A *Sabella* resembling the *Penicillus*, Montagu. Test. Brit., p. 544.
 1829. *Sabella lucullana*, Delle Chiaje. Memorie, vol. iii, p. 218, Tav. xlii, fig. 23.
 1835. „ *ventilabrum*, Sars. Beskr. og. Iagtt., p. 47.
 1843 ?. *Clymeneis stigmosa*, H. Rathke. Nova Acta Acad. C. L. C., xx, p. 226, Tab. ix, figs. 10—14.
 1843–53. *Amphitrite lucullana*, Chenu. Illust. Conch., 11^e livr., pl. vii, fig. 2.
 1845. *Sabella carnea*, Johnston. Ann. Nat. Hist., xvi, p. 449.
 1846. *Dasychone* (*Sabella*) *lucullana*, Grube. Arch. f. Naturges., p. 46, Tab. ii, fig. 3.
 1851. *Sabella lucullana*, Sars. Reise i. Lofot. og. Finm., p. 82.
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 1853. *Amphitrite bombyx*, Dalyell. Pow. Creat., ii, p. 236, pl. xxxi, figs. 1—7, pl. xxxii, figs. 1—13, and pl. xxxiii.
 „ *Sabella Lucullanna*, Sars. Nyt Mag., Bd. vii, p. 390.
 1856. *Sabella pumila* and *infarcta*, Krøyer. Overs. Kgl. danske Vid.-Selsk. Forhandl. Kjöbenhavn, p. 121.
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 1863. „ „ idem. Nyt Mag., t. xii, p. 319.

1863. *Dasychone argus*, idem. Indberet. acad. Kongl. Fred.-Univer., p. 67 (sep. copy).
- „ *Sabella polyzonos*, Grube. Arch. f. Naturges., xxix, p. 68, Tab. vi, fig. 5.
1864. „ „ idem. Insel Lussin, p. 90.
1865. *Dasychone argus*, De Quatrefages. Annel., t. ii, pp. 666 and 670.
- „ *Sabella verticillata*, idem. Ibid., t. ii, p. 440, pl. xx, figs. 3 and 4.
- „ „ *bombyx*, Johnston. Cat. Worms Brit. Mus., pp. 246 and 261.
- „ „ *Savignii*, idem. Ibid., p. 261.
- „ *Dasychone argus*, Malmgren. Nord. Hafs.-Annul., p. 403.
1867. „ *Dalyelli*, Malmgren. Annul. Polych., p. 115.
- „ *Sabella bombyx*, Parfitt. Cat. Annel. Devon, p. 34.
- 1868-9. *Dasychone argus*, Grube. Schles. Gesellsch., pp. 110 and 128 (St. Vaast-la-Hougue).
1870. *Sabella verticillata*, idem. Arch. f. Naturges., p. 349.
1871. *Dasychone inconspicua*, G. O. Sars. Christianiafiord, p. 416.
1874. „ *Dalyelli*, Malm. Göteborg K. Vetensk. Handl., p. 101.
- „ „ „ McIntosh. Ann. Nat. Hist., ser 4, vol. xiv, p. 206.
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- „ *Dasychone lucullana*, Marion and Bobretzky. Ann. Sc. nat., 6^e sér., t. ii, p. 93.
- „ „ *Dalyelli*, McIntosh. Invert. and Fishes St. Andrews, p. 130.
1877. „ *argus*, Grube. Monatsb. Königl. Akad. Wiss. Berlin, Aug., p. 512.
1878. „ *Bombyx*, Chatin. Ann. Sc. nat., 6^e sér., t. vi, p. 28, pl. iii, figs. 40—42.
1879. „ *Dalyelli*, Tauber. Annul. Danica, p. 137.
1883. „ „ Levinsen. Vidensk. Meddels. Kjöbenhavn, p. 186.
1885. „ *polyzonos*, Carus. Fauna Medit., i, p. 272.
1889. „ *infarcta*, Marenzeller. Arch. f. Naturges., lv, p. 132.
1891. „ *herdmani*, Hornell. Trans. Biol. Soc. Liverp., vol. v, p. 262, pl. xv, figs. 1—9.
1893. „ *lucullana* and *polyzonos*, Lo Bianco. Atti R. Accad. Sc. Nap., vol. v, No. 11, p. 72.
1894. „ *bombyx*, De St. Joseph. Ann. Sc. nat., 7^e sér., t. xvii, p. 309, pl. xi, figs. 323—326, pl. xiii, figs. 327—336.
1896. „ „ Roule. Camp. "Caudan," p. 461.
1897. „ *Dalyelli*, Michaelsen. Polych. deutsch. Meere., p. 180.
1904. „ „ Journ. M. B. A., vol. vii, p. 231.
1909. „ *bombyx*, Fauvel. Ann. Sc. nat., 9^e sér., t. x, p. 210.
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- „ „ „ Fauvel. Bull. Instit. Oceanogr., No. 194, p. 37.
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1913. „ *lucullana*, Ehlers. Deut. Südpol. Exped., p. 570.
- „ „ *bombyx*, Stephenson. Trans. Roy. Soc. Edin., vol. xlix, p. 806.
1914. „ *infarcta*, Fauvel. Campag. Sc. Monaco, xlvi, p. 318.
- „ „ *bombyx*, Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 139.
1915. „ „ Allen. Journ. M. B. A., vol. x, p. 642.
- „ „ „ Southern. Irish Sc. Invest., No. 3, p. 49.
1916. „ *argus*, McIntosh. Ann. Nat. Hist., ser. 8, vol. xvi, p. 29.
1917. „ *bombyx*, Rioja. Anél. Poliq. Cantáb., p. 70.

Habitat.—Tossed on shore on the West Sands, St. Andrews, after storms (R.M.) ; dredged on dead shells in ten fathoms off St. Peter Port, Guernsey ; under stones between tide-marks,

Herm and Guernsey; between tide-marks, Lamlash, Arran (Dr. Howden); thirty fathoms off Bantry Bay, S.W. Ireland, Royal Irish Academy's Expedition, 1885, where the species seems to be abundant, groups of three or more being fixed to the surface of littoral sponges. Plymouth (Spence Bate and B. Rowe). Bay of Galway (E. P. Wright). Between tide-marks, Malahide, Co. Dublin (A. C. Haddon); Dublin Bay and West Coast of Ireland (Southern). A common form in the older collections of Cocks, Leach and others from the southern coasts and now in the British Museum. Cosmopolitan. Shores of France (Fauvel), Spitzbergen (Meyer), Norway, Sweden, Heligoland (Malmgren); Teneriffe (De Quatrefages); Finmark (Norman). Coast of France, Dinard (De St. Joseph); Shores of Cantabria (Rioja); Mediterranean, Adriatic, Sargasso Sea (Grube); Antarctic Seas (Ehlers).

When the branchiæ have been shed, the edge of the collar projects beyond the surface of the cephalic plate (Plate CXXI, figs. 2 and 2*a*), which shows at the dorsal inflection two small processes or folds from which a pear-shaped area passes ventrally to end in the oral ridge. The entire surface is thus symmetrically mapped out, whilst the margin is formed by the collar, which presents a lateral notch—in the form either of a slit or a shallow excavation—marking off the reflected and somewhat triangular ventral lobes from the rest of the brim, whilst they are separated from each other by a wider gap in the mid-ventral line (Plate CXX, fig. 14*a*). In large examples a dark speck occurs on each side of the surface external to the pear-shaped enlargement, and another on each side of the dorsal collar. A patch of dark brown pigment also is present in some on the edge of each reflected lobe. When the annelid withdraws itself into its tube, the dorsal lamellæ are folded inward and slightly overlap, and the inner process is pressed flat.

The branchiæ (Plate CXXI, figs. 1 and 1*a*) arise from firm chordoid tissue which is continuous in each semicircle, and apparently formed by the fusion of the bases of the branchiæ, the individual elements being marked by a reddish-brown pigment-speck, linear in outline and interfilamentar in position. From each semicircle the finely coloured organs freely extend distally. The chordoid axis in each is more finely divided than in *Chone infundibuliformis*. The pinnæ, which are in a double row, become shorter at the tip and somewhat suddenly cease at the base of the short terminal process. Along the outer edge of each filament about eighteen clavate processes are attached in pairs (Plate CXXI, figs. 1 and 1*a*), and a pigment spot occurs on each side just beyond the point of attachment. The processes in life are often carried downward. Sars calculated that there were from 1200 to 1400 eyes in this species, for each eye-speck is compound. As a transparent object, the branchial filament shows the chordoid axis (*a*, Plate CXXI, fig. 1*c*) with its coating of hypoderm and cuticle, and the pinnæ present also jointed chordoid axes.¹ In some from Guernsey and one from Plymouth (Plate CXIII*A*, fig. 5) the branchiæ were of a pale greenish hue, whilst the pinnæ were pale or whitish, and the tentacles greenish. Zetlandic examples, again, had the branchiæ tinted dull orange with a tinge of green, whilst on each filament the pinnæ and the dorsal processes were marked with white grains. Others from St. Peter Port, Guernsey, had dull purplish red branchiæ spotted with white. Four of the dorsal crenated processes in some were also white. In those from St. Andrews the branchiæ are often brownish purple, and the two tentacular processes are streaked longitudinally with white and purplish brown. The beautiful shades of white and purplish brown and the elegant form of these complicated

¹ De St. Joseph calls the axis cartilaginous.

organs almost baffle description. The general effect of the branchial coloration is striking (Plate CXII, fig. 6), for three broad reddish-brown belts cross the branchiæ, the most intense being inferior; thereafter the colours tone down to the white collar. Two white belts separate the three brown bands, and various white touches enliven the beautiful fan. Dalyell's were variegated with different shades of brown and yellow, and he mentions one with snow-white plumes located inside an old oyster-shell.

The pigmented tentacles or palpi (Plate CXXI, fig. 1*a*) are large organs, tapered from base to apex, and with a deep groove which in the spirit-preparations is directed dorsally, but which in the living and expanded condition of the parts may be directed inward. The groove is deeply tinted with brown pigment. Their bases are fused to the basal region of the branchiæ, and to the central mass, and they are shed with them, and probably perform important functions in directing currents to the alimentary canal.

The *body* (Plate CXII, fig. 6) is moderately elongated, but in contraction almost elliptical, and attains a length of three quarters to two inches, and has fifty-eight well-marked segments, of which five to seven are anterior. It is rounded on the dorsal surface, and devoid of any anterior groove, slightly flattened ventrally, and with a median groove from the posterior border of the ninth bristled segment to the tail, where the terminal anus has two small lateral papillæ. The ventral surface from the collar backward has in each segment a glandular scute. These occupy the middle of the anterior region. The long rows of hooks occur at the sides and they continue of similar breadth to the posterior end. After the ninth, the ventral glandular shields are split in the mid-ventral line by the groove, and in some a faint line runs from the collar along the middle of the anterior segments. The body is of a madder-brown or dull red (orpiment-orange, Dalyell) colour in some with white specks both dorsally and ventrally. In others it is dull orange with only a few whitish grains on the collar; or of a light orange hue—rendered dark here and there by the intestine. The lobes of the collar are speckled with minute dots of white, and two white papillæ occur at the anus, or a white patch in front of it. Young examples between tide-marks in Guernsey and Herm are yellowish green, with the dark speck at each foot. A bold dark brown speck occurs at the ventral edge of each setigerous process in the anterior region, the uncinigerous ridge commencing behind it. At the ninth bristled segment a smaller speck is situated rather behind the setigerous process dorsally, and at the commencement of the uncinigerous row, and so to the posterior end of the annelid. In one from Malahide the collar had many minute brown specks. The alimentary canal commences at the mouth as a wide though translucent membranous tube marked by transverse striæ. About the middle of the body it becomes narrower and thicker with powerful and rather coarse transverse fibres and more delicate longitudinal muscles. The dissepiments fix the canal in every segment, and thus it assumes a moniliform aspect, or occasionally resembles a coiled spring.

The first setigerous processes are nearer each other than the succeeding since the line of the bristles anteriorly trends dorsally. The conical first is smaller than the second, and bears a series of bristles with more slender winged tips (Plate CXXIX, figs. 1 and 1') than the succeeding. A typical tuft in the anterior region (Plate CXXIX, fig. 1*a*) presents dorsal bristles with more elongated striated shafts, and short, tapering winged tips. The shaft slightly tapers toward the wings and again toward the insertion. Those at the edge of the series (Plate CXXIX, fig. 1'') have somewhat broader wings, which are striated and serrated

on the edges. A shorter series of bristles occurs at the base, the tips just projecting beyond the skin, and these have the same gradation as observed in the longer forms. The posterior bristles form a small tuft (Plate CXXIX, figs. 1*b* and 1*b'*), and are characterised by the great elongation of the tips, especially of the more slender forms, the wings in the preparations being scarcely visible. One or two bristles at the ventral edge have the wings considerably widened at the base, but the tips are attenuate. On examining the anterior tufts of bristles with a lens, the sharpest curve formed by the setigerous process is posterior, and the concavities are dorsal. They are considerably stronger than the succeeding tufts. The ninth is less powerful and the dorsal bristles are proportionally longer. In transverse section (Plate CXXIX, fig. 1*d*) they agree generally with the conditions observed in *Chone fauveli*.

The first bristle-tuft has no hooks on its ventral border, but the next seven have long ventral rows slightly diminishing in length from before backward, and the hooks occur in a single series. The ninth, which begins the posterior series, is dorsal, and is about one-third less in breadth than the eighth. Throughout the entire series of rows the hooks maintain the same microscopic characters. The anterior hooks (Plate CXXIX, fig. 1*e*) are avicular, have the posterior outline convex and the anterior concave, the main fang leaves the throat at a little less than a right angle, and a series of small teeth occur on the crown above it. The anterior outline, whilst concave at the neck, becomes boldly convex at the prow, which is smoothly rounded anteriorly and inferiorly, ending in a strap-like basal process, which is usually bent a little downward. The hooks diminish in size posteriorly, and the basal process is shorter (Plate CXXIX, fig. 1*f*). The outline, however, is the same.

The posterior hooks of *Dasychone lucullana* from Naples have the same general outline as in *D. argus*, but as the specimens are much smaller than the British the teeth on the crown are less distinct; eight or nine teeth occur in lateral view from the crown on the slope to the main fang—leaving about half the edge smooth. The forward bulge of the prow is marked, and the posterior outline is strongly convex—with a broad but short basal process. The curved striæ a little behind the prow pass into the basal process. In the larger *D. argus*, the teeth above the great fang are ten or eleven; the crown goes further backward, so that the posterior curve is less convex. The posterior basal process is similar, but often smaller than in the other form, and the striæ behind the prow are bolder. One or two oblique striæ also appear in some on the neck. Other specimens, however, as in that figured, agree in the posterior curve with the Neapolitan form, so that they seem to be varieties of the same species.

Habits.—In confinement it readily expands its branchial fan, and is less shy than many others. Moreover, a fresh and transparent tube is rapidly secreted if the annelid be left under favourable circumstances.

Reproduction.—Dalyell (1853) had specimens which spawned in May, June, August and September, the white ova being immersed in the thinnest gelatinous matter. He found that, after the loss of the branchial plumes, in fifteen days, the “rudiments of a regenerating plume rose, as several shoots one-eighth of an inch long, and in others three specks on the back of the ribs were visible. Incipient fringes began to clothe the latter, and in twenty-three days from the date of mutilation the branchiæ had attained a third of the dimensions of those they were replacing.” In another example the plume “proved a fine reproduction” in two months; whilst in a third, viz., a portion of the posterior end of the body, 116 days elapsed

before the plume “ unfolded in nearly the natural figure ”—developed *de novo* on the fragment, the plumes on the anterior fragment being undisturbed. Having thus been successful in the case of a bisected specimen, he next cut a *Dasychone* into three fragments, anterior, middle and posterior, and each formed a sheath. In three weeks the middle section had generated a new plume about one-eighth of an inch long ; and in fifty-five days the posterior extremity, originally of about a dozen segments, presented eight perfect branchiæ and two tentacles. Under these circumstances Dalyell remarked that when we attempt to eradicate an organ, some imperceptible atom may escape destruction, and survive to enlarge in its place, but the same argument is inapplicable to the evolution of similar parts on another site. “ Here we seem to reach a postulate, demanding the indefinite—the universal diffusion of germs, ready for development wherever the obstacles to it cease, or of some creative power, effecting a secretion of such matter as may produce new organs, in form and substance.” Pangenesis was thus thought of before Darwin. This author likewise observed that “ the tentacles have the power of transmitting particles up the back.”

R. Wägener¹ (1832) describes *Sabella lucullana*:—“ Tubulis erinaceis, transversis, rugosis, inferne coalitis.” He mentions the external processes and the pigment-spots on the branchial filaments. The general structure of the body is similar to that of his *S. ventilabrum*. He also alludes to *Sabella nuda*—a form without the processes on the filaments and a tube immersed in sponges and Alcyonarians, but identification is difficult. It may be the young of his *Sabella ventilabrum*. Unfortunately his figure is not diagnostic (fig. 8). His *Sabella euplacana* is a Serpulid (fig. 9) with two opercula, the ends of which have long processes. It may be *Hydroides norvegica*. He figures (fig. 10) *Serpula fimbriata*, Delle Chiaje—apparently copying Delle Chiaje’s figure. It has spinous ribs along the tube.

Lo Bianco (1909) mentions that at Naples *Dasychone lucullana*, D. Ch., had a circlet of ova at various stages in a gelatinous matrix at the mouth of its tube—from December to April. This author (1893) separates *D. argus* (his *lucullana*, D. Ch.) from *Dasychone polyzonos*, Grube, the latter, however, being synonymous with *Dasychone* (*Branchiomma*) *Dalyelli*, Köll., and *Dasychone argus*, Sars. This confusion is avoided by the diagnosis adopted in this work.

Delle Chiaje, Grube and Claparède found that the fertilized ova are borne by the females like a collar in the anterior part of the tube. The development of *Dasychone lucullana* is described and figured by Claparède and Mecznirow² (1868) from the egg onward to the formation of the branchial filaments. In the cleavage the two larger somatoblasts posteriorly are characteristic. The larva is monotrochous, pear-shaped, with a prototroch and two well-marked eyes furnished with lenses. Palpocils occur on the anterior margin, and the alimentary region is indicated by large granular cells.

In the next stage the body is more elongated, has three bristled segments, the eyes have moved inward on the dorsum so as to be nearer each other, and the rudiments of the branchial apparatus appear as two broad dorsal flaps. The alimentary canal shows pharynx, glandular intestine and rectum. Then the branchial rudiment bifurcates, afterwards becomes multifid, and the head-lobe is evident from the under surface. At a further stage the six or seven branchial filaments elongate, the body lengthens, but the eyes remain ; whilst a little later,

¹ ‘Isis,’ 1832, p. 654, taf. x, fig. 7.

² ‘Zeitschr. f. wiss. Zool.,’ Bd. xix, p. 197, taf. xvi, figs. 1—16.

when eight or nine segments are present, the eyes disappear, and the branchial filaments have a tendency to bifurcation, but are yet devoid of eye-specks.

In a young example procured at the East Rocks, St. Andrews, in May, 1867 (R. M.), and measuring in all about 4 mm., there are twenty-nine bristled segments; the dorsal processes of the branchiæ are proportionally large and slightly clavate in outline. Four pairs occurred on each filament. The collar is well formed. The vent has two prominent papillæ.

De St. Joseph (1894) found a young form of 5 mm., viz., 3 for the body and 2 for the branchiæ. Five pairs of branchiæ were present, each with five pairs of eyes; six anterior and twenty-four posterior segments.

The *tube* is composed of tough secretion, often of a brownish hue and more or less coated with mud. On shell-ground in 10 fathoms, off St. Peter Port, Guernsey, the tubes were surrounded by fragments of shells and a young *Arca* may be included. The same occurred in a small specimen found under a stone between tide-marks at Herm, and under similar circumstances at Lamlash, Arran. Algæ also occasionally grow on the tubes and the structures attached. Off Bantry Bay the tubes were of tough secretion coated with greyish mud, and comparatively long. Dalyell observed that the fresh secretion is as clear as crystal, but becomes opaque subsequently. It can form several tubes in succession. De St. Joseph (1894) notes that, when detached from the site to which it is adherent, it rapidly pours out secretion and attaches neighbouring objects. The tube is horizontal in position.

The *Sabella lucullana* of Delle Chiaje¹ and subsequent authors seems to be a very closely allied form, the descriptions so far being insufficient for discrimination from the British species. Its tube is similar. An anterior bristle, with broader wings, is shown in Plate CXXIX, fig. 2; a curved form in Plate CXXIX, fig. 2a, and a hook in the same plate, fig. 2b, and another from a specimen sent from the Naples Zoological Station in Plate XXVIII, fig. 6. All agree with the typical form.

Claparède (1868), in *Dasychone lucullana*, found that the lateral branches of the vascular *rete* enveloping the intestine had a series of contractile blind appendages, as in *Protula Dysteri*, Huxley. Some of these are simple and others ramified.

Roule² (1884-5) gives an account of the development of *Dasychone lucullana*, D. Ch., the eggs of which he found early in April immersed in a voluminous mass of mucus. By the 20th of May the larva had only two segments.

De St. Joseph (1894) describes the eyes of this form as composed of twenty to thirty rods, terminating in crystalline cones, surrounded by pigment, and he thinks the appendages of the branchial filaments protect them when in the tube.

There is nothing in Hornell's *Dasychone Herdmani* (1891) to distinguish it from the present species.

Bernardi (1911) considers that this form may be *D. lucullana*, D. Ch., for both Grube and Kölliker have found *D. bombyx* in the Mediterranean, and the distinctions in regard to segments, the appendages of the branchial filaments and the longer palpi are not material. The same view is held by the author.

Fauvel (1914) observes that the branchiæ of *Dasychone infarcta*, Kröyer, from St. Vaast-

¹ 'Memorie,' p. 218, tav. xlii, fig. 23; 'Descrizione,' p. 72, tav. xcvi, fig. 23.

² 'Revue Sc. Nat. Montpellier,' 3^e sér., t. iv, p. 463.

la-Hougue, bear pairs of smaller appendages than in *D. bombyx*, Dalyell, but distinguished by their form, which is flattened-spatulate, and also that they do not cover the eyes as in *D. bombyx*. There are nine setigerous segments anteriorly; the lateral eyes are situated between two pinnules, and thus differ from *D. bombyx*, but there is variation in the shape of the branchial appendages in the ordinary form, and also in their relation to the eyes. In all probability Kröyer's form is only a variety. The tube resembles that of *Sabella penicillus*.

Genus CLXXI.—EUCHONE, *Malmgren*, 1865.

Collar fairly developed, with a deep dorsal fissure and a small ventral notch. Branchiæ forming two half circles; united nearly to the tip by a membrane, and with a broad web on each side of the free process. Tentacular cirri two to ten, smooth, filiform and unequal in

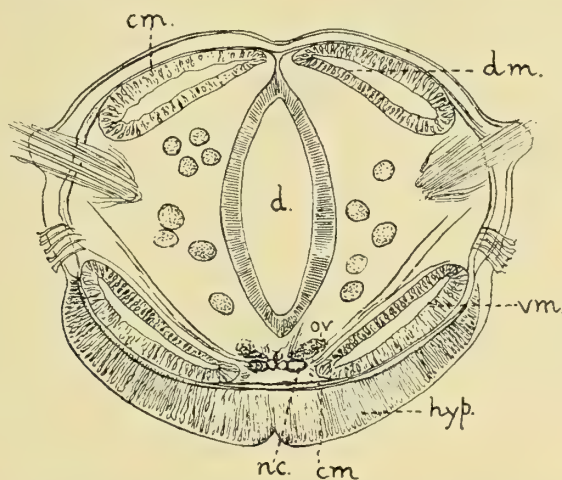


FIG. 157.—Transverse section of *Euchone analis*, Kröyer, about $\frac{1}{8}$ of an inch from the front and in the line of the feet. ov., ovary. $\times 30$.

length. Body sublinear, slightly flattened, a little attenuated posteriorly, and having the anterior region of eight to twelve segments. Dorsal groove anteriorly, and a well-marked ventral groove behind. Segments biannulate. Posteriorly it presents a scoop-shaped anal region slanting from above downward and backward. Setigerous processes commence on the second segment and continue to the posterior end. Anterior bristles of two kinds—dorsal with elongate winged tips, ventral with spatulate tips. Rows of hooks commence on the second bristled segment, and continue to the end. Hooks as in *Chone* anteriorly and posteriorly.

In *Euchone analis* transverse section in front shows the hypoderm greatly developed on the ventral surface (Fig. 157), thinning off in the lateral regions, and with a slight groove mid-dorsally. The dorsal longitudinal muscles form an almost complete loop in section, the broader end of each being external, and the mesenterial attachment of the alimentary canal separates them in the middle line. The folds of the ventral longitudinal muscles are also almost continuous. A little behind the foregoing the ventral surface is marked by a deep groove. The alimentary canal is much enlarged and its lumen occupied by folds of mucous membrane. Toward the posterior end the muscles at first indicate no change, though

the dorsal loop presents a hiatus at its ventral edge. Both dorsal and ventral longitudinal muscles are proportionally thicker and the body-wall more compact—Fig. 158. The aspect of each muscle wholly alters about an eighth of an inch from the tip of the tail. Each dorsal muscle in section shows a continuous thick arch superiorly, the inner end bending downward and forming a coil of a turn and a half, whilst the outer and thicker end does the same. Each ventral muscle, on the other hand, makes a single coil of one turn and a half from its outer end, and thus forms a contrast with the double coil in each dorsal. Special functions would thus appear to be provided for in the caudal region of this form.

FIG. 158.

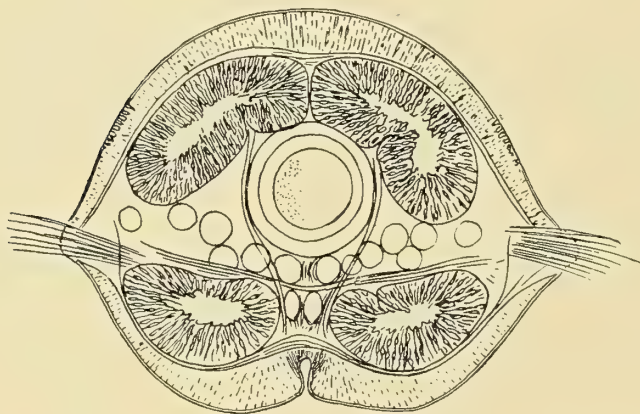


FIG. 159.

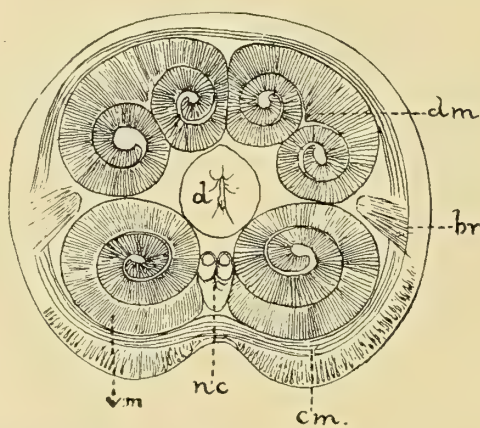


FIG. 158.—Transverse section of *Euchone analis* about $\frac{1}{8}$ of an inch from the tip of the tail. $\times 30$.
 FIG. 159.—Transverse section of *Euchone analis* about $\frac{1}{8}$ th of an inch from the tip of the tail. *br.*, bristles; *cm.*, circular muscle; *d*, intestine; *dm.*, dorsal muscle with its coils; *vm.*, ventral muscle with its large coil; *nc.*, nerve-cords with neural canals.

1. EUCHONE RUBROCINCTA, Sars, 1862. Plate CXXXI, figs. 2—2a—bristles and hook; Plate CXXXVIII, figs. 9 and 9a—posterior hooks.

Specific Characters.—Collar curved as it approaches the median dorsal fissure; ventrally there is only a spout-like median fold. Branchiæ fifteen to sixteen on each side, webbed for half their length. Filaments with numerous pinnæ to the base of the slender filiform extremity. Narrow hypodermic wing from base of slender tip along a portion of filament. Tentacles two, somewhat ligulate; tentacular cirri six to seven, thread-like. Body about $\frac{3}{4}$ inch in length, of thirty-two or more segments, nine to eleven being included in the anal funnel, which has a furrowed process in front and a crenulated margin. Segments two-ringed, with a dorsal furrow which extends in the preparations to the posterior end. The anterior part of the groove passes to the ventral surface between the eighth and ninth segments, and is continued to the anal funnel. Anterior bristles of two kinds, the shorter ventral with comparatively narrow wings and curved shorter tips, the longer dorsal with tapered winged tips. The posterior bristles have long hair-like tips and narrow wings. Anterior hooks large, with long boldly curved shafts, narrowed above the shoulder. A main fang which comes off nearly at a right angle, and a flat crown with eight to nine teeth. Posterior hooks avicular, the terminal (caudal) forms having a much higher crown and more numerous teeth than those in front of the same region (usually five

or six in front). Both have a rudimentary posterior basal process, a prominent prow, and the posterior outline is convex. Colour of the body pale reddish, anteriorly reddish-carmine. Branchiæ carmine with yellowish bands; cirri with whitish spots irregularly disposed; tentacular filaments pale (Lo Bianco).

SYNONYMS.

1862. *Chone rubrocincta*, Sars. Forh. vid.-selsk., 1861, p. 128.
 1863. „ „ idem. Indberet. acad. Colleg. Kongl. Fred.-Universit., p. 66.
 1874. *Euchone rubrocincta*, Malm. Annel. Göteb., p. 101.
 1883. „ „ Marion. Ann. Mus. Hist. Nat. Marseille, t. i, p. 26.
 1893. „ „ Lo Bianco. Atti. R. Accad. Sc. Nap., vol. v, No. 11, p. 78.
 1914. „ „ Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 144.
 1916. „ „ McIntosh. Ann. Nat. Hist., ser. 8, vol. xvi, p. 33.

Habitat.—Dredged in 80—100 fathoms in St. Magnus Bay, Shetland, July, 1867 (J. G. Jeffreys), Ballynakill Harbour, 1—8 fathoms (Southern).

Abroad it occurs in Norway. Sars found a species of *Euchone* at 300 fathoms, Skagerak; Gulf of Marseilles (Marion). Mediterranean at considerable depths (Lo Bianco).

The *collar* dorsally has a curvature as it approaches the median fissure, whilst ventrally only a spout-like median fold occurs at the rim. The branchiæ are fifteen to sixteen on each side (12, Sars), connected by a web for half their length. The filaments have pinnæ which reach the base of the slender filiform tip (often so closely coiled as at first sight to represent a knob). A narrow hypodermic wing is attached to the axis along a considerable area of the pinnate region and to the base of the terminal process. “Five pairs of branchial tentacles (tentacular cirri) and several unbranched, of which one long ventral pair is attached to the connecting membrane of the branchiæ, whilst the others are free” (Southern). These organs are in close proximity to the mouth, have an afferent and efferent blood-vessel, and are probably of importance in alimentation. The course of the vessel is just within the hypodermic tip, which is slightly bulbous.

The *body* reaches about three-quarters of an inch in spirit, has thirty-two or more segments, of which nine to eleven are included in the anal funnel, which has a furrowed process in front and a crenulated margin. It is somewhat rounded, though the ventral surface is more or less flattened, a little tapered in front, and more distinctly diminished in the caudal region. The segments are two-ringed, and a dorsal furrow runs from end to end, for it does not cease when the ordinary groove bends to the right as it passes to the ventral surface between the eighth and ninth segments, and is continued to the anal funnel. The anterior scutes are divided by the transverse furrow of the segment; the posterior scutes are cut into four by the deep and broad ventral groove.

The anterior bristles are borne on setigerous processes, and are pale and brittle. The first tuft, which arises a little more dorsal than the others and at the base of the collar, consists of a longer and shorter series of finely tapered bristles with very narrow wings, those on the shorter series being almost invisible. The average anterior tuft presents three sets of bristles, the longer (Plate CXXXI, fig. 2) having straight shafts and gently tapered and slightly curved tips; the next series (Plate CXXXI, fig 2') has shorter tips with a distinct inclination backward, and broader wings, but still their condition is in contrast with the broad spatulate

tips of the corresponding series in such as *Euchone papillosa*. The third series has narrower wings than the last, and the tips project little beyond the surface. So brittle are the tips that the tapered axis or terminal region of the shaft often snaps at the base of the wing, leaving a transparent web (forming the wings) projecting freely beyond it and on one side of the shaft.

In his account of the species, Malmgren (1865) did not refer to other than the anterior hooks (Plate CXXXI, fig. 2*a*), which are rather large, have moderately long and boldly curved shafts, also as brittle as the bristles. These dilate from the base up to the shoulder, then are slightly narrowed at the neck. The main fang comes off nearly at a right angle, and in lateral view has eight or nine teeth above it, but the crown is flat, and thus differs from such as *E. papillosa*, in which the crown is more elevated. The hooks in the anterior part of the posterior region are avicular, have a main fang which leaves the neck at less than a right angle, a rather high crown with five or six teeth in lateral view, a convex posterior border, a prominent and massive prow, and a small basal process posteriorly. The terminal hooks (Plate CXXXVIII, figs. 9 and 9*a*) again are considerably smaller, have a much higher crown and more numerous teeth in lateral view above it, and the posterior basal process is smaller. All the shafts of the bristles and long hooks are slightly brownish by transmitted light.

Southern (1914) observes: "The short capillary setæ at the base of the spatulate setæ, which might be called the basal setæ, for convenience, have the characteristic "bayonet"-bend of the shaft, and are distinctly winged. These basal setæ form a useful specific character in many species of Sabellidæ, but have only been figured in a few cases. The naked tips of the branchiæ are filiform. The usual row of glands encircles the body behind the setæ of the second setigerous segment. There are thirty-one to thirty-two setigerous segments, of which nine to eleven form the anal funnel."

Reproduction.—Mature specimens were found by Southern between March and November.

2. *EUCHONE RUBROCINCTA*, VAR. *NORMANI*, McIntosh, 1916. Plate CXX, fig. 15—scapha ; Plate CXXXI, figs. 6—6*d*—bristles and hooks.

Distinctive Characters.—Cephalic collar fairly developed, fissured dorsally, and sloping downward and forward to the mid-ventral region, where a slight projection occurs on each side with a fissure between. Body short; anal funnel wide but short antero-posteriorly, margin thin and deep, anteriorly with a shallow median notch, sides boldly crenate for fully the anterior half. Anterior bristles of two kinds, the dorsal with finely tapered tips and narrow wings, and the ventral with shorter tips and broader wings. Anterior hooks have strong, curved shafts tapering to the base, neck narrowed above the shoulder, main fang at a right angle and four teeth in lateral view above it. Posterior hooks avicular, with an inflection below the crown in the posterior outline and a short basal process posteriorly. Anterior outline begins below the main fang at less than a right angle and the prow is prominent whilst the base is abbreviated.

SYNONYM.

1916. *Euchone Normani*, McIntosh. Ann. Nat. Hist., ser. 8, vol. xvi, p. 34.

Habitat.—Dredged in the Zetlandic Seas by Dr. Gwyn Jeffreys and Canon Norman.¹

Unfortunately the example is fragmentary and nothing is known of the branchiæ. The cephalic collar is fairly developed, with a deep fissure dorsally, the margin sloping thence downward and forward to the ventral process, a slight projection with a fissure between occurring on each side of the middle line. The *body* appears to be comparatively short, and the anal funnel is short antero-posteriorly and wide (Plate CXX, fig. 15), the margin being thin and deep, anteriorly with a shallow median notch, whilst the sides are boldly and somewhat regularly crenate for more than the anterior half. Its general aspect thus differs from that in *Euchone analis*.

The anterior bristles are of two kinds, a longer series dorsally with finely tapered tips and narrow wings (Plate CXXXI, fig. 6), and those ventrally situated with broader wings and shorter tips (Plate CXXXI, fig. 6a). Posteriorly the tips of the bristles are greatly elongated, and the wings very narrow (fig. 6d).

The anterior hooks (Plate CXXXI, fig. 6b) have a long, curved shaft tapering to the base, whilst the neck is narrowed above the shoulder and curved backward. The main fang comes off nearly at a right angle, and about four teeth are on the crown above it in lateral view, whereas in *Euchone analis* the number of teeth is nearly doubled, and a differentiation of this region from that of the chief fang is evident. The posterior hooks are even more diagnostic than the anterior. The posterior outline (Plate CXXXI, fig. 6c) is convex, with a slight inflection below the crown, and a short posterior curve at the base, which is small. The great fang is long and sharp, and on the crown above it are six or seven distinct teeth. The anterior outline begins at a little less than a right angle, gently curves forward to the prow, which inferiorly blends with the short, truncate base. The lower part of the neck and body have curved striæ. In structure, therefore, these hooks differ from those of *E. analis*, Krøyer, and *E. papillosa*, Sars.

So far as can be observed, this form appears to be a variety of *Euchone rubrocincta*, but the details will be useful in coming to a decision in regard to the several species of *Euchone*, which at present need further study.

M. Sars² (1861) describes in *Euchone papillosa* a parasitic Copepod, *Chonephilus dispar*, with an elongated body, rounded or laterally compressed (female narrowed in front), the middle broader, thorax of four segments; the male broader anteriorly and thorax of six segments. Abdomen narrower than the thorax with five segments. Head separated from the thorax. Rostrum bifurcate. First antennæ short, with five segments; first two segments dilated and spinous; distal three flexed at a right angle with the former, bearing flagella or two membranaceous appendages, cylindrical uni-articulate, longer in the male, second pair foot-like, 4-articulate, distal segment with three hooks. Maxillipedes in females not seen; in male quadriarticulate, subcheliform, distal segment with a curved claw, three pairs of biramose triarticulate natatory feet. Fourth pair rudimentary, uniarticulate, a single, subglobose dorsal ovarian sac.

It is difficult to know what the precise relations of Claparède's (1868) *Dialychone* is to *Euchone* and *Chone*. It appears to come very near the former, though Claparède states that

¹ Canon Norman and Dr. Gwyn Jeffreys did much valuable work with the dredge in the Zetlandic seas as well as elsewhere in British waters.

² 'Forhandl. Vidensk.-Selsk. Christ.,' p. 140.

he has not seen the interbranchial membrane. Further investigations on this head are necessary, as both anterior and posterior hooks are in close resemblance.

3. *EUCHONE ROSEA*, *Langerhans*, 1884. Plate CXXIX, figs. 8 and 8a—hooks.

Specific Characters.—Cephalic collar wide, the anterior border being curved outward. Five pairs of branched cirri and several pairs unbranched, of which one long ventral pair is attached to the connecting membrane. Two eyes on the cephalic segment; two statocysts on the first bristled segment (Langerhans). (No eyes or otocysts, Southern). Body 4 mm. long, of a roseate colour; setigerous segments twenty, eight being anterior and twelve posterior. Anal scoop of four segments with an anterior median fold, and two lateral; pygidium with two eyes (Langerhans). Branchiæ three to five on each side with a short, subulate process at the tip of the filament. The first setigerous segment has only dorsal capillary bristles, six long with conspicuous wings, the second row shorter, with curved tips and delicate wings. The other thoracic segments have tufts in which the upper are longer than the lower bristles, whilst inferiorly are spatulate forms. Below these are characteristic bristles with a double curvature and winged. The anterior crotchets have long shafts, a main tooth, four smaller teeth above it and a delicate wing. Posteriorly the bristles are long, slender and winged. Posterior hooks avicular, with a main fang, several teeth above it, and a narrow gulf beneath it. The anterior "abdominal" hooks have fewer teeth above the main fang than the posterior, as Langerhans shows.

SYNONYMS.

1884. *Euchone rosea*, Langerhans. Zeitschr. f. wiss. Zool., Bd. xl, p. 271, Taf. xvi, figs. 35a—l.
 1914. „ „ Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 144, pl. xv, figs. 33A—K.

Habitat.—Ballynakill Harbour, 1—3 fathoms (Southern). Abroad it occurs at Madeira on coral ground in deep water (Langerhans).

The *cephalic* region bears a wide collar, the anterior border of which is curved outward, the dorsal margin infolded, but ventrally only slightly indented. The basal process for the branchiæ bears two eyes in the examples from Madeira, none in the Irish. The terminal portions of the thoracic "excretory organs" appear as dots under the collar.

Three pairs of branchiæ occur in those from Maderia, five pairs in the Irish, and Southern counted about twenty-six pinnæ on the filaments, which end in a bare subulate tip.

Body of nearly uniform width, tapering, however, toward the tail, which has two eye-spots in the southern forms, none in the Irish. Ventrally are opaque-white glands or scutes, two on each segment in front, four posteriorly, since the ventral groove splits them.

Two kinds of bristles appeared in the example kindly sent by Mr. Southern, viz., the longer dorsal with finely tapered tips and distinct wings, and the inferior with broader wings so as to render the tip slightly spatulate. Both are pale and translucent. Southern describes and figures (fig. 33F) a bristle with a narrowing of the shaft at the commencement of the wings, but he found none of the wingless capillary forms shown by Langerhans. The posterior bristles, as usual, have much more elongate, tapering winged tips.

The anterior hooks (Plate CXXIX, fig. 8) are characterised by their comparatively short form, marked curvature of the anterior region, enlargement below the shoulder, which is sometimes indistinct, a main fang coming from the short neck nearly at a right angle, and three or four teeth on the crown above it.

The posterior hooks (Plate CXXIX, fig. 8a) have a slightly indented posterior outline, a main fang and four or five distinct teeth above it. The gulf below the main fang is rounded and slightly narrowed at its anterior outlet. The base is nearly straight, or with a tendency to a slight projection where the outline turns with a curve upward to the prow. The posterior hooks thus approach in outline those of *Euchone analis*.

Reproduction.—Southern found mature examples in September.

So far as observed, the distinctions between this and *Euchone analis* rest on the minuteness of *E. rosea*, and the higher crown of the posterior hooks with the larger number of teeth above the main fang. The anterior shorter hooks and the narrower wing to the paddle-like tip of the shorter bristles are other features of moment. A comparison with the young of *E. analis* would be interesting.

Much of the foregoing description is taken from the accounts of Langerhans and Southern, the latter author especially having gone into greater detail and furnished excellent figures. There are certain discrepancies between that described by Langerhans and the Irish representative, such as the absence of statocysts and eyes anteriorly, and the larger number of branchiæ in the Irish example.

Genus CLXXII.—CHONE, Kröyer, 1856.

Cephalic lobe continuous, except at the dorsal fissure. Body slightly tapered anteriorly, and more distinctly so posteriorly, where it ends in an anus. It is more or less rounded throughout. A sulcus runs from the cephalic fissure dorsally and bends on the right to the ventral surface behind the eighth bristle-bundle, and thereafter continues in the mid-ventral line to the tail. The anterior region of the body has eight segments, the bristles, which begin on the collar-segment, are dorsal, with the rows of hooks beneath them on the side of the body. At the ninth the condition is reversed, the hooks being dorsal and the bristles beneath them. The bristles are of two kinds—dorsal with tapering tips, ventral with spatulate tips. The hooks, which commence on the second setigerous segment of the anterior region, have elongated shafts; posteriorly they are short and avicular. The segments are two-ringed. There are no ventral scutes. Branchiæ forming a funnel, the filaments having a naked winged tip, but connected by a membrane for more than half their length. Tentacular cirri round, filiform, unequal, occasionally rudimentary or absent.

The structure of the body-wall in *Chone Fauveli* is as striking as that of *Euchone*. The cuticle covers a highly glandular hypoderm, which in the mid-dorsal groove is more finely granular, and may have special sensory functions. The circular muscular coat is strong—Fig. 160. The dorsal longitudinal muscles are largely developed, and in two concentrically arranged bands in transverse section, the outer layer, however, extending over the dorsum of both. The median band is somewhat triangular, with the apex internally, the outer is ovoid, and the alimentary canal is attached in the mid-dorsal line so closely

that no mesentery is apparent. The ventral longitudinal muscles likewise form two areas, the base of each being central, the apex on either side. The inner edge of each muscle is separated by a considerable gap in which the nerve-cords lie. Each has a small neural canal. At half-an-inch in front of the tip of the tail no evident dorsal notch occurs in the hypoderm, but a deep median groove exists ventrally—Fig. 161. The circular muscular coat is still conspicuous. Each moiety of the dorsal longitudinal muscle is now separate, the outer being

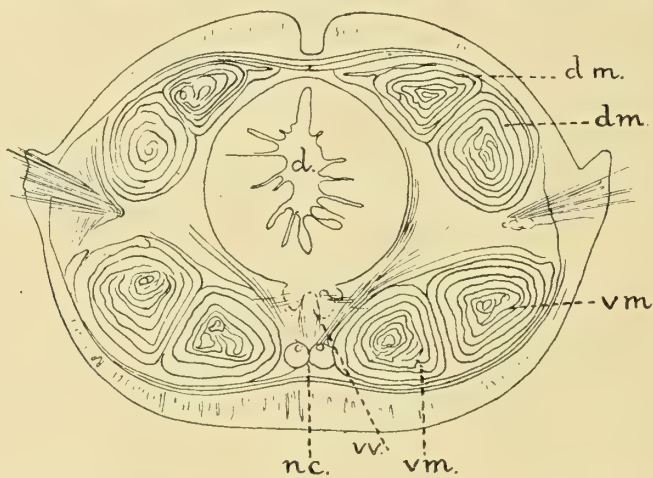


FIG. 160.—Transverse section of the body-wall of *Chone Fauveli* about half an inch from the front. The outlines indicate the complex volutions of the muscular fasciculi. Letters as before.

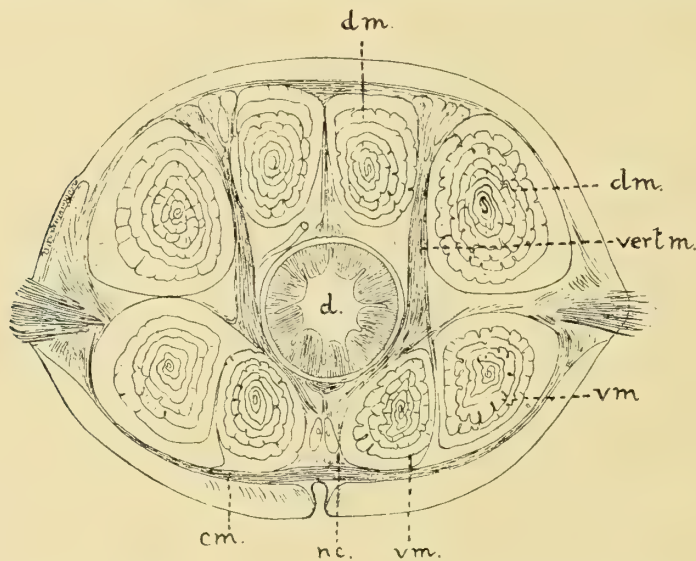


FIG. 161.—Transverse section of *Chone Fauveli* half an inch in front of the tip of the tail.

the larger, and between it and the inner a strong vertical band of muscular fibres leaves the dorsum, joins the oblique, and passes to the outer side of the nerve-trunks, in each of which a small neural canal exists at the upper part, the nerve tissue completely surrounding it.

The representatives of the genus *Chone* in northern waters seem to be in a somewhat confused condition, since the young of certain forms have been described as different species. At least five species, however, are clearly defined, viz., the characteristic *Chone infundibuliformis*, Kröyer, of the Arctic Seas, which appears to be rare in most collections, but was procured by the "Valorous" in 1875. This form has often been confounded with another species,

viz., *Chone Duneri*, Malmgren; indeed, in a named collection from Greenland procured in the sixties of last century from Hamburg it is labelled *C. infundibuliformis*. Yet the form of the tips of the branchiæ in the latter, the structure of its hooks, especially the avicular posterior hooks, the bristles, and other features are diagnostic.

The original description of *C. infundibuliformis* by Kröyer,¹ although unfortunately he gives no figure, is clear in regard to the structure of the branchiæ, the collar, the size, and other features. He adds that it is not rare in Greenlandic seas, and that it inhabits a cuticular tube devoid of mud; yet modern naturalists seem to have seldom met with it. Its posterior hooks are so characteristic that no confusion with *C. Duneri* need occur—even in young forms of each species. It may be a question what form Kröyer meant by his *C. infundibuliformis*, since both it and *C. Duneri* are found in the Arctic Seas, but the typical *C. infundibuliformis* is chiefly Arctic in distribution, whereas *C. Duneri* has a much wider range. After careful consideration of Malmgren's views and of various specimens, it has been deemed prudent to adhere to the diagnosis indicated above. It is, however, right to state that Prof. Fauvel and others hold *C. Duneri* to be Kröyer's *C. infundibuliformis*, and that the species held here to be *C. infundibuliformis* is only a variety of the former (*C. Duneri*). This, after careful examination, does not modify either the opinions or the figures in this work.

Chone Duneri has a very wide distribution, ranging from the British Seas to Norway, Jan Meyen, Spitzbergen, Greenland, the Gulf of St. Lawrence and Madeira. A species, which closely approaches *C. Duneri*, extends along the eastern shores of Scotland, is thrown by storms on the sands at St. Andrews, is dredged in deep water off Montrose, and occurs in the stomachs of fishes such as the cod and haddock. It has been termed *C. Fauveli*² in the meantime, since the processes at the tips of the branchiæ form a contrast with the long, filiform processes in *C. Duneri*, and its posterior hooks generally show a tooth more above the main fang. Further investigations may clear up certain doubtful points in connection with both forms. Wollebæk's³ view that *C. Duneri* is a synonym of *C. infundibuliformis* cannot be corroborated. In the fine volume on the Polychæts procured by the Prince of Monaco, Prof. Fauvel⁴ describes and figures *C. Duneri* as *C. infundibuliformis*, and it is possible that the rarity of the latter and the abundance of the former in northern waters have led to this interpretation, which formerly we in Britain equally shared. Prof. Fauvel's figures of the bristles and hooks in his account of the Polychæta from Jan Mayen are excellent. In all probability the species from the area of the Clyde⁵ is *Chone fauveli*, and not *C. infundibuliformis*, which has not hitherto been met with in British waters. The species described by Miss Katherine Bush⁶ as *Chone teres* appears to be closely allied to the last-mentioned species, especially in the structure of its posterior hooks. Besides the foregoing forms, *Chone Reayi*

¹ 'Oversigt Kgl. danske Videnskab. Selskabs Forhandl.,' 1856—57, p. 33.

² After Prof. P. Fauvel, of the University of Angers, France, who has done much good work in the group.

³ 'Skrift. Videnskap. Selsk. Kristiania,' 1911, 2 Bind, No. 18, p. 24.

⁴ 'Campagne Scient.,' fasc. xlvi, p. 319, pl. xxxi, figs. 10—18 (1914).

⁵ 'Proc. Roy. Irish Acad.,' vol. xxxi, no. 47, p. 141.

⁶ 'Harriman Alaska Exped. Tubicol. Annel., New York,' 1905, p. 215, pl. xxx, fig. 1, and pl. xxxvii, figs. 16—23.

extends from Shetland to the Channel Islands, and *Chone Princei* occurs in the Gulf of St. Lawrence, Canada.

1. CHONE FAUVELI, *McIntosh*, 1916. Plate CXXI, figs. 2—2c—body, cephalic plate, ova, tube; Plate CXXX, figs. 2—2b—bristles and hook.

Specific Characters.—Cephalic plate surrounded by an ample and continuous collar cleft only at the dorsal fissure and ensheathing the base of the branchiæ, which are fixed to a firm, horse-shoe-shaped rim. Body rounded, 5—6 inches in length, and having fifty to ninety segments. Anterior region of eight segments. It is slightly narrowed anteriorly toward the collar, and is tapered for a short distance at the tail, at the tip of which is the anus. The deep dorsal fissure is continued to the second segment, and thence the dorsal groove passes backward to the anterior border of the eighth segment, where it inclines to the right, and reaches the mid-ventral region of the ninth segment—thereafter proceeding to the tip of the tail. The branchiæ vary from twelve to thirty-six on each side, and they are connected together by a membrane almost to the tip, the dorsal fissure, however, causing a gap in the funnel. In the preparations they are slightly spiral or twisted, and the tips curved inward. Each filament is stiffened by a camerated chordoid axis as in *Sabella*, and a jointed axis enters each pinna. The pinnæ are numerous, and specially elongated at the base around the mouth so as to resemble cirri. The two tentacles occur at the edge of each ventral fold. Bristles of the anterior region—except those of the first segment—of two kinds, viz., a dorsal series with elongated tapering and winged tips, and a ventral in which the tip of the shaft terminates abruptly, and a spatulate outline is given by the short broad serrated wings. They are dorsal to the rows of hooks. Posteriorly the bristles are all of the elongated kind with tapering winged tips, and are ventral to the rows of hooks. Rows of long hooks commence on the second bristled segment, and are double anteriorly. Shaft of hook long, curved and striated, tapering inferiorly, a shoulder below the translucent neck, and with five smaller teeth on the crown above the main fang. At the ninth bristled segment the avicularian hooks begin and continue to the posterior end. They form a single row, and have a broad, squarish base, a main fang and about four teeth above it. Tube lined by a tough membrane and more or less coated with sand.

SYNONYMS.

In the following list of synonyms it has been thought prudent to give the entries for *Chone infundibuliformis*, since the distinctions between this and *C. Fauveli* were unknown.

1780. *Tubularia penicillus*, Fabricius. Fauna Grœnl., p. 438.
 1843. ? *Sabella volutacornis*, Rathke. Nova. Acta. Acad. C. L. C., xx, p. 223, tab. xii, figs. 1—4.
 1851. „ *infundibuliformis*, Sars. Nyt Mag., Bd. vi, p. 203.
 1856. *Chone infundibuliformis*, Krøyer. Danske Vid.-selsk. Forh., p. 33.
 „ *Sabella paucibranchiata*, idem. Ibid., p. 22.
 „ ? *Chone suspecta*, idem. Ibid., p. 33 (young ?).
 1861. ? „ *Kroyeri*, Sars. Forhandl. Vidensk.-selsk. Christ., p. 126.
 1865. „ *infundibuliformis*, Malmgren. Nord. Hafs.-Annul., p. 404, Tab. xxviii, fig. 87.
 „ „ „ De Quatrefages. Annel., t. ii, p. 466.
 1867. „ „ Malmgren. Annul. Polych., p. 116, Tab. xiv, fig. 79.

1877. *Chone infundibuliformis*, Marenzeller. Denksch. Kaiserl. Akad. Wissensch. Wien, Bd. xxxv, p. 36, sep. abd.
- " " " Michaelсен. Polych. deutsch. Meere., p. 181.
1878. " " McIntosh. Trans. Linn. Soc., ser. 2, Zool., p. 508.
1879. " " Tauber. Annul. Danica, p. 137.
- " " " Théel. Kgl. Sv. Vet.-Akad. Handl., Bd. xvi, p. 66.
1880. " " Marenzeller. Ann. Nat. Hist., ser. 5, vol. vi, p. 271.
1883. " " Wirén. Chætop. "Vega" Exped., p. 422.
- " " " Levinsen. Vidensk. Meddel., p. 186.
1886. " " Marenzeller. Polarforsch., p. 15.
- " " " Levinsen. Kara-Havets, etc., p. 13.
1888. " " Cunningham and Ramage. Trans. Roy. Soc. Edin., vol. xxxiii, p. 670, pl. xlv, fig. 32.
1889. " " Marenzeller. Arch. f. Nat., lv, p. 132.
1894. " " Bidentkap. Christ. Vid.-selsk. Forhandl., p. 132.
1896. " " Appellöf. Berg. Mus. Aarb., xiii, p. 12.
1898. " " Michaelсен. Grönland. Annel., p. 130.
1909. " " Fauvel. Bull. Inst. Oceanogr., cxlii, p. 45.
- " " " Moore. Proc. U.S. Nat. Mus., vol. xxxvii, p. 145.
1912. " " Ditlevsen. Danmark Eksped. Grönl., Bd. v, p. 429.
1913. " " Augener. Zool. Anz., Bd. xli, p. 271.
- " ? " " Fauvel. Bull. Mus. Hist. Nat., p. 91.
1914. " " idem. Campag. Scient. Monaco, xlvi, p. 319.
1916. " *fauveli*, McIntosh. Ann. Nat. Hist., ser. 8, vol. xvii, p. 36.

Habitat.—Tossed on the West Sands, St. Andrews, in considerable numbers after storms (R. M.), and also obtained from the lines of the fishermen (E. M.). Stomach of plaice, Moray Firth; Clyde area (as *C. Duneri*), Gemmill.

[The distribution (of *C. infundibuliformis*) is extensive :—

Greenland, Spitzbergen (Kükenthal) and Finmark, Norway (Sars, Malmgren); Finmark (Norman). 300 fathoms off Norway (Sars); Atlantic Coast, U.S.A. (Verrill); Siberian and Behring's Sea (Wirén); Kara-Havets (Levinson); Barents Sea (McIntosh); Franz-Joseph-Land (Augener); N.E. America (Moore). It has not yet been found in British seas.]

The cephalic plate of *C. fauveli* is surrounded by an ample and continuous collar, cleft, however, at the dorsal fissure, and it ensheaths the base of the branchiæ. At the dorsal fissure the thickened edges, after the collar ceases, are carried downward and end in a point above the inflection of the firm rim to which the branchiæ are attached, and which has the outline of a horse's hoof, the rounded ventral arch forming the front, and the indented dorsal region the frog. After the branchiæ are shed, a small papilla is usually found in the mid-dorsal and a larger in the mid-ventral line of the thickened inner rim. The mouth lies above the ventral papilla.

The *body* of this form is generally more rounded than in the Sabellids proper, reaches the length of 5—6 inches, and has the thickness of a strong goose-quill. The segments are from fifty to ninety. The outline is somewhat spindle-shaped, for though the cephalic lobe is truncate, the body tapers to it, as well as more distinctly toward the tail. At the tip the vent in the younger examples sometimes shows two papillæ, a smaller dorsal and

a more prominent ventral papilla. The deep dorsal fissure is continued to the second segment, where it is dilated, and from this the mid-dorsal groove passes backward to the anterior border of the eighth segment, then it inclines to the right—cutting off in its course ventralward a narrow portion of the ninth, and, reaching the mid-ventral line in this segment, thereafter proceeding to the tip of the tail, the last part of its course being generally more deeply grooved in the preparations. The body of the fresh specimen is pale pinkish, and in the newly preserved form is of a pale skin-colour.

The branchiæ vary from twelve to thirty-six on each side, and are connected together almost to the tip by a membrane—the dorsal fissure, however, causing a gap in the funnel. In preserved examples the filaments are often slightly spiral, and the tips are incurved. The filament is stiffened by a chordoid camerated axis as in *Sabella*, and it is not less in diameter. The tip of each process is characteristically formed—with a broad wing at the base and tapering to a fine point. A slender axis, apparently from the chordoid skeleton, passes along the centre of the flattened tip almost to its extremity. The pinnæ are long even to the base of the flattened terminal process, and have a central (chordoid) axis, the tip being smoothly rounded or occasionally slightly enlarged. The pinnæ at the bases of the filaments—that is, near the mouth—are elongated, the last one or two being so long as to resemble cirri. In the centre are two or three folded lobes apparently in connection with the oral aperture, and near the dorsal fissure is an oblique fold of some length, the distal end of which is split into filaments. The two tentacles proper are on the inner border of each ventral fold, and they terminate in a tapering filament. When a suitable example is observed, the slender cirri arise at each side of the mouth and are quite free from the branchiæ. Six or more occur on each side as delicate filaments little tapered distally. The mechanism of the entire elaborate apparatus is complex. The length and degree to which the tip is webbed vary considerably, and in the Arctic form it is more elongate.

The cutis is smooth, has a finely iridescent or nacreous lustre, and when removed has a bluish aspect. In intimate structure it is crossed by fine lines, which give it a fibrous appearance, but at the segment-junctions white bands occur, and these are tessellated. A series of powerful circular fibres occurs beneath the skin and its basement-tissue, whilst the longitudinal bands conform to the type of the family.

The collar runs smoothly into the first segment, which is of considerable antero-posterior diameter and uniformly rounded. It has on each side, a little in front of the segment-junction, a small tuft of bristles and a pale spine. The bristles are simple winged forms, with tapering tips, the edges of the wings being serrated. They slant dorsally and forward. Some of these long anterior bristles present a peculiar twist below the wings, but whether this is artificial or otherwise is unknown. The succeeding seven pairs (which issue just in front of the median ring) have modified tufts, consisting of a dorsal series of bristles with tapering tips like those of the first series, with serrated edges, and a ventral series of spatulate bristles (Plate CXXX, fig. 2 and sections), the slope of both being obliquely upward and forward. The spatulate bristle is smallest at the base and gradually enlarges into a finely striated shaft, which remains cylindrical until the wings appear, and then tapers to a blunt point. The wings rapidly widen on each side and soon end in a blunt tip. Moreover, the tip often presents a slight marginal fold. The anterior tufts of simple bristles (at and after the ninth) are characteristic when contrasted with the northern *Chone infundibuliformis*

from Greenland, for in lateral view the shafts are curved, constricted as they approach the wings, and the tip leaves the shaft at an angle, whilst it is finely tapered and bordered with the narrow wings. In antero-posterior view the constriction at the upper end of the shaft is distinct, the base of the tip (continuation of the shaft) being considerably broader. On the other hand, the bristles of the Greenlandic species are much more slender, the tips longer and more attenuate, and the wings just visible. The constriction of the shaft below and its dilation above the commencement of the tip scarcely attract notice. They are obliquely striated, and have serrated edges laterally. When the tip of the shaft is broken, the transparent web connecting the wings is evident, and the margins of the wings are stiffened by an incurvation and slight thickening. There is little difference between the first tuft and the last except that the posterior are rather more obtuse at the tip. In transverse section the exterior of the bristle is hyaline, the centre granular from the fibres. On examining the bristle-tufts of this region with a lens, a double series of black dots appears—caused by the central stalk of each spatulate bristle.

A change occurs at the ninth bristle-bundle, which is now ventral to the row of hooks, for all have tapering tips with the serrate wings, and slant upward and backward. The succeeding tufts are equally powerful, and have the same direction till the posterior fifth is reached, and there the bristles gradually assume an opposite direction—that is, slant downward and forward. These posterior bristles are longer and smoother, present no serrations, and the terminal wings are narrower, so that the shaft is more conspicuous. The free portion of the bristle increases disproportionally, the shaft being little more than quarter the length (Plate CXXIX, fig. 6*a*). Further, whilst the bristles of the anterior region are in front of the median ring of the segment and the hooks behind it, the posterior bristles are more nearly in a line, though still anterior to the row of hooks. Generally speaking the anterior bristles have most of their shaft below the skin and a shorter tip, whilst the posterior have a short shaft under cover, and a long tip—conditions doubtless connected with their functions.

The rows of hooks commence on the second bristled segment to the ventral side of the bristles, and the first seven—that is, those of the anterior region—are longer and more boldly marked than the succeeding, appearing like minutely dotted dark lines under a lens. The hooks (Plate CXXX, fig. 2*b*), are arranged alternately in a double row, but toward the ends of the row, especially ventrally, appear to form a single series. Each presents a long curved, striated shaft, deeply inserted into the muscular coats, and tapering from the well-marked shoulder to the base (which extends even further than in the figure). The neck is translucent, finely striated, especially superiorly, narrowed above the shoulder, and again slightly dilated as it approaches the head, which has a powerful main fang extending from the throat at more than a right angle, and with five or more smaller teeth on the crown in lateral view, and they extend to the downward curve of the crown posteriorly. The hooks in the seven rows maintain the same structure, the posterior perhaps being slightly stronger. In transverse section of the shaft of the hooks the centre is fibrous, and at the shoulder it is somewhat flattened and has an indentation of the fibrous area (Plate CXXX, fig. 2*a*), a condition which explains the peculiar blank always seen on one side of the shaft. At the ninth segment the hooks change to the dorsal side of the bristles, and they maintain that position to the posterior end of the body. These hooks (Plate CXXX,

fig. 2*b*) are avicularian and form a single row, diminishing in size from the dorsal to the ventral end adjoining the bristles. There are about thirty-six hooks in each row anteriorly. Moreover, the hooks at the upper end of the row have a larger base than those next the bristles, for in the last hooks the base is in a line with the neck and devoid of the anterior prow. In the upper hooks the main fang is large and sharp, the anterior outline below it deeply concave to the prow, after which it is nearly straight. Four distinct teeth occur above the main fang. The posterior outline is irregular, a slight hollow occurring at the neck, then a convexity, from which a straight line runs to the angle at the upper part of the base, another straight line joining that bounding the free end. The base and neck are boldly striated, the former transversely, the latter longitudinally. At the lower end of the row the posterior outline of the hook is nearly straight, only a slight elevation occurring in the middle, whilst the anterior outline of the base is prolonged downward with a slight posterior inclination, so that it has a base elongated in the line of the neck. In some large forms from St. Andrews these hooks were of a deep brown hue.

In contrasting these with the hooks of *C. infundibuliformis*, the curvature is less, the neck shorter, and the crown somewhat flatter. Moreover, whilst the body of the arctic specimen is larger, the hooks are proportionally smaller. In *Chone infundibuliformis* the hook (Plate CXXIX, fig. 6*b*) in the middle of the body considerably diverges from that of *C. fauveli*, since the base is more massive, the prow has a slight process projecting downward, and the gulf below the acute main fang, instead of having a nearly uniform outline on its inner edge, has a distinct indentation, marking off, as it were, the region of the prow. But the most divergent feature is the crown, which is flattened, and provided at its posterior edge only with five or six small teeth in lateral view—in contrast with the four large teeth of the British form, which project well over the main fang, and the striæ from which occupy a considerable portion of the neck; the striæ adjoining (in front) are parallel to these, whereas in the arctic hook the long striæ from the smaller teeth on the crown are indistinct, those in front being alone conspicuous. The posterior outline in the two hooks likewise differs, the arctic form being evenly convex till near the base, where it is truncated, the British having this portion of the posterior edge concave. The distinctions noted continue posteriorly. Thus the bristles near the tip of the tail in the British form, while they have greatly elongated tips, retain the marked constriction of the shaft below the tip, and the dilatation beyond it. On the other hand, the extremely slender tips of *C. infundibuliformis* have only a trace of wings, and the slight constriction of the shaft below and dilatation above the commencement of the wings would not at first sight be noticed. The terminal hooks in the British form have a more regular posterior outline, but otherwise keep to the type seen in front, the main fang and the teeth above it being specially distinct; on the other hand, those of *Chone infundibuliformis* retain all the distinctive features already mentioned, the minute teeth at the back of the flattened crown being so indistinct as to suggest fusion.

When the digestive tract of *C. Fauveli* is exposed, it presents anteriorly prominent oral papillæ and glandular organs on each side. The anterior region of the tract is brownish in colour, chitinous and very pliable, and after a short course it merges into a rounded and more distinctly moniliform portion, which, gradually diminishing in calibre, ends in a small anus. The contents of the gut showed many diatoms, fragments of the spicules of sponges, fragments

of minute crustacea, amidst muddy sand. A large and firm glandular body is attached to the intestine, and above the intestine lies the dorsal blood-vessel, which has in the preparation a brownish, barred aspect.

The anterior half of the intestine is of a pale brownish hue and somewhat firm, as if chitinous, and in minute structure is finely striated transversely, and hence the readiness with which it ruptures. Few muscular fibres occur in the anterior region of the gut, but at the point where it becomes moniliform a layer of muscular fibres lies beneath the firm coat, which becomes thin and translucent posteriorly, whilst the muscular fibres increase in bulk and power. A complex reticulation of blood-vessels covers the wall of the canal anteriorly. Strong fibres from the body-wall cross the canal, but are not attached to it. The intestine is coated throughout with the brownish digestive glands, which are deeply tinged with yellow pigment. They cease within a quarter of an inch of the vent.

Reproduction.—Small ova were found in the coelomic space in October.

Tube.—In one a tough tube of secretion of a brownish or ochreous hue occurred anteriorly. The pigment was amorphous. The posterior part, again, was coated with sand-particles, a few minute fragments of shells and spines of *Spatangus*. In some the tube is of a tough gelatinous nature rendered opaque by sand-grains, the translucent portions being ochreous. A small variety in tough semitranslucent tubes comes from Finmark (A.M.N.).

M. Sars (1861) describes *Chone Krøyeri* as a new species—measuring about 40 mm. in length. It has fewer branchiæ (eight to ten), but this and other divergences may be due to age, the example perhaps representing a young form.

Prof. Fauvel (1913) differs from the conclusions stated in the foregoing pages, and after examination of specimens from the Kara Sea, Jan Meyen, Spitzbergen and other regions, groups all under *Chone infundibuliformis*, Krøyer. He does not, however, differentiate *Chone Duneri*, and, as indicated in the text and figures, it has been thought best to adhere to views published in the 'Annals of Natural History' in January, 1916. An interesting comparison of the bristles and hooks of Prof. Fauvel's *Chone infundibuliformis*, with text-figures, is given in the 'Bull. Mus. Hist. Nat.' 1913, No. 2, p. 91.

2. CHONE DUNERI, *Malmgren*, 1867. Plate CXXX, figs. 3—3c—bristle and hooks.

Specific Characters.—Cephalic collar resembles that of *C. infundibuliformis*, sloping downward and forward to an even and continuous rim ventrally. Branchial filaments six to twenty-two in number, on each side, comparatively long, with long, slender, terminal processes, which taper to a delicate tip and are winged; united by membrane throughout the greater part of their length. Pinnæ long, only a few shorter occurring near the commencement of the terminal process. Body smaller than in *C. infundibuliformis* or *C. Fauveli*; flattened and grooved anteriorly on the dorsum, and having a median groove ventrally from the ninth scute backward to the anus, with its papilla; segments about fifty. Anterior bristles (eight pairs) in two groups, an upper with longer shafts and tapering, winged tips, and a lower series of spatulate forms with a short process at the tip. The posterior bristles have the tips much elongated. The anterior hooks, though smaller, resemble those of *C.*

Fauveli, but the posterior part of the crown is less rounded and its three or four teeth very sharp. The posterior hooks (avicular) have higher crowns than in *C. Fauveli*, with four teeth above the main fang; the posterior part of the crown is less rounded, and the main fang shorter.

SYNONYMS.

1867. *Chone Duneri*, Malmgren. Annul. Polych., p. 116, Tab. xiii, fig. 75.
 1877. „ „ Marenzeller. Denksch. Kaiserl. Akad. Wissensch. Wien, Bd. xxxv, p. 36, sep. abd.
 1878. „ (another), McIntosh. Trans. Linn. Soc., ser. 2 Zool., p. 508, pl. lxxv, figs. 18 and 19.
 1880. „ *Duneri*, Marenzeller. Ann. Nat. Hist., ser. 5, vol. vi, p. 271.
 „ „ „ Langerhans. Zeitschr. f. wiss. Zool., Bd. xxxiv, p. 114, Taf. vi, fig. 44.
 1883. „ „ Wirén. Chætop. 'Vega' Exped., p. 422.
 „ „ „ Levinsen. Vidensk. Meddel., p. 186.
 1894. „ „ Bidekap. Christ. Vid.-selsk. Forhandl., p. 133.
 1897. „ „ Michaelsen. Polych. deutsch. Meere., p. 180.
 1909. ? „ „ Moore. Proc. U.S. Nat. Mus., vol. xxxvii, p. 145.
 1913. „ „ Hofsommer. Wiss. Komm. Meers. deutsch., xv, p. 336.
 1914. „ „ Southern. Proc. Roy. Irish Acad., vol. xxxi, p. 141.
 1916. „ „ McIntosh. Ann. Nat. Hist., ser. 8, vol. xvi, p. 42.

Habitat.—Variety in 7 fathoms, Bressay Sound. Dredged at a depth of 53 fathoms by the "Knight Errant," at Station 3, 3rd and 4th August, 1880. It is interesting that small loosely reticulated siliceous sponges somewhat resemble the branchiæ of such forms and are found in company. Clew Bay (Southern). A specimen from the Clyde is labelled in the British Museum *Ariippasa infundibulum* (64. 6. 30. 2).

Abroad it occurs as follows:—Spitzbergen (Malmgren), Madeira (Langerhans), Siberian and Behring's Seas (Wirén), Barents Sea (Marenzeller), N.E. America (Moore), Gulf of St. Lawrence, Canada, at Station 2, 1872 (dredged by Dr. Whiteaves); Atlantic Coast, U.S.A. (Verrill).

The cephalic collar forms a considerable process dorso-laterally, passing backward to the line of the second bristle-tuft and doubling forward along the edge of the dorsal fissure on each side so as to make conspicuous parallel edges to the fissure, as far as the base of the pedicle for the branchiæ. The pedicle after removal of the branchiæ does not project beyond the rim of the collar. The branchiæ are distinguished by their comparative length, and the long slender terminal processes. The structure of the filaments is typical, and they slightly taper distally, ending in a remarkably long winged process which tapers to a delicate tip, and has a slender continuation of the chordoid axis in the centre. The number of filaments ranges from six to twenty-two on each side according to size, the latter being the number in a fine example from Jan Meyen kindly sent by Prof. Fauvel, and they are united by membrane throughout the greater part of their length—the tip being free. The pinnæ are of considerable length—each having the jointed chordoid axis. They continue long till near the basal web of the terminal process, when a few shorter occur.

The *body* in all the examples observed is considerably smaller than that of *C. Fauveli*, and is nearly of the same diameter throughout the anterior three-fourths, though a little tapered

in front. It then diminishes gently to the tail, which is by no means acute. It is somewhat flattened and grooved anteriorly on the dorsum, and grooved ventrally from the ninth scute backward. A papilla marks the anus at the tip. The number of segments would appear to be about fifty, and they are distinctly marked, with the exception of the minute caudal rings. The anterior bristles (Plate CXXX, fig. 3) are in two groups—an upper with longer shafts and tapering winged tips, and a lower of spatulate forms (Plate CXXX, fig. 3a) with a short tapering process at the tip. The tufts are fewer and smaller than in *C. Fauveli*. Posteriorly in front of the tail the tips of the bristles are greatly elongated, and they slope forward rather than backward, projecting on each side as a fine fringe.

The anterior hooks (Plate CXXX, fig. 3b) are similar to those of *Chone Fauveli*, though smaller, the posterior part of the crown is less rounded, and the three or four teeth above it very sharp. The posterior hooks (Plate CXXX, fig. 3c), while generally resembling those of the common species, have somewhat higher crowns—five to six teeth being clearly visible above the main fang. The posterior part of the crown is also less rounded, as is the posterior outline. The main fang is proportionally shorter, since its point does not project beyond the line of the prow. Another feature is that the crown with its small teeth is on a level with the outer surface of the main fang, whereas in *C. Fauveli* the four large teeth above the main fang fit into a convex outline. The figure of Langerhans,¹ though poor, clearly indicates the species.

Reproduction.—Southern found a ripe male in August.

The *Chone longocirrata* of Sars may be an allied form. Chamberlin² again makes a new species, *Chone ungavana*, of a form from Hudson Strait, King George's Sound, and the posterior hooks certainly do not agree with those of *C. Duneri* or other species, though considerable variation occurs.

3. CHONE FILICAUDATA, *Southern*, 1914. Plate CXXXI, figs. 1, 1'—1b—bristles and hooks.

Specific Characters.—Cephalic region with a somewhat narrower collar than in *C. Fauveli*, entire ventrally, infolded dorsally. Lip-membrane terminates ventrally in a bifid process. Branchiæ eight to nine pairs, connected by a membrane almost to the tip of the filaments, which end in a bare subulate process. They are about half the length of the body. Body short and stout, 11 mm. long, about twenty-eight setigerous biannulate segments, of which eight are anterior and twenty posterior, the first and last achetous. It tapers toward the tail, which ends dorsally in a filiform cirrus or process. The dorsal longitudinal groove passes to the mid-ventral surface, and is continued from the first segment of the posterior region to the tail. Bristles of the anterior region of three kinds, viz., long slender forms with narrow striated wings, spatulate forms, and a series with delicately pointed tips and very narrow wings. All the shafts are longitudinally striated and dotted. Posterior bristles with attenuate tips and narrow wings. The anterior hooks have long, slightly curved shafts, very little dilated below the shoulder, with a main fang which leaves the neck at a little more than a right angle, and several teeth above it. A delicate wing occurs behind the crown (*Southern*),

¹ 'Zeitschr. f. wiss. Zool.,' Bd. xxxiv, p. 114, Taf. vi, fig. 34.

² 'Canad. Arctic Exped. Polych.,' p. 26, pl. vi.

but this has not been seen in the preparations. The posterior hooks somewhat resemble those of *Chone Duneri*, but have the five or six teeth above the main fang more distinct.

SYNONYMS.

1910. *Chone infundibuliformis*, Southern. Proc. Roy. Irish Acad., xxviii, p. 215.
 1914. „ *filicaudata*, idem. Ibid., vol. xxxi, No. 47, p. 141, pls. xiv and xv, figs. 32 A—L.
 1916. „ „ McIntosh. Ann. Nat. Hist., ser. 8, vol. xvi, p. 45.

Habitat.—Inishlyre Harbour, Ballynakill Harbour, Dingle Bay and Dublin Bay (Southern).

The *cephalic collar* is somewhat narrower and less prominent than in *C. Fauveli*, is infolded dorsally, entire on the ventral aspect, and does not slope obliquely as in *C. Duneri*. The lip-membrane terminates on the ventral side in a bifid process.

The branchiæ are eight or nine pairs, besides one ventral filament devoid of pinnæ attached to the branchial membrane, and an inner ring of similar filaments of varying number and length. The ordinary filaments are connected nearly to the tip by a membrane, and the terminal naked processes are subulate. The branchiæ are fully half the total length of the animal.

The *body* is short, stout, 11 mm. long, of about twenty-eight setigerous biannulate segments, eight being anterior and twenty posterior. It tapers a little toward the tail, which ends in an anus ventrally, with a filiform cirrus dorsally. The anterior region is marked by a dorsal groove, which passes at the end of the region to the mid-ventral surface to be continued to the tail. Numerous glands occur on the ventral surface. The body is whitish in preservation.

The first setigerous segment is narrow and bears long winged bristles in a row with others in which the wings are very narrow. The typical anterior bristles (Plate CXXXI, figs. 1 and 1') have long slender shafts with narrow striated wings; beneath are slightly spatulate forms, which taper gradually to a point, and thus differ from those of *C. Duneri* and *C. Fauveli*. Slender wingless forms occur at the base of the latter. The posterior bristles differ chiefly in the great elongation of the finely tapered tips, which have a characteristic bend at the origin of the wing.

The anterior hooks (Plate CXXXI, fig. 1a) have long slightly curved shafts which dilate upward till near the shoulder. The main fang comes off at more than a right angle to the neck, and three or four teeth occur above it; whilst Mr. Southern observed a delicate wing at the back of the crown, as in the Spionids.

The posterior hooks (Plate CXXXI, fig. 1b) are avicular, the posterior outline having a slight incurvation, the basal margin sloping downward and forward, and then upward to the prow. The main fang has a small gulf beneath it, and there are six or seven distinct teeth above it, so that the crown is high. These hooks toward the tip of the tail show a diminishing series in each row.

This form differs from *Chone Duneri*, Malmgren, which it approaches in the presence of a bifid process of the lip-membrane, in the form of the posterior hooks, which have a higher crown and more numerous teeth above the great fang in lateral view. It also has a conical

anal appendage. The terminal process of the branchial filament has a central axis and a web on each side. It is the rule for the posterior hooks in most species of this genus to have higher crowns. The occurrence of a caudal filament in *Chone Duneri* in certain cases, however, makes the distinction less evident, yet the posterior hooks diverge. Further examination may reveal intermediate forms, and connect this with known species.

4. CHONE REAYI,¹ *McIntosh*, 1916. Plate CXXI, figs. 3 and 3a—body; Plate CXXX, figs. 1—1d—bristles and hooks; 1e and 1f—collar-region; Plate CXXXI, fig. 5—tip of branchia.

Specific Characters.—Cephalic plate with a thinner collar than in *C. Fauveli*, and the dorsal edges are turned in, sloped inward and downward, to be fixed to the first segment on each side of the middle line. Bases of branchial fans project beyond the collar, and are constricted posteriorly so that the whole is mushroom-like. Branchiæ have filaments with long pinnæ in a double row which near the base of the smooth terminal process are short and give a character to the organs. Body shorter and smaller than in *C. Fauveli*, the largest example having about fifty-five segments, rounded anteriorly, and only flattened ventrally at the posterior third as it tapers to the tail, the tip of which projects as a special process with an oblique end. From the dorsal groove anteriorly a furrow runs to the end of the seventh segment, then slants to the right across the eighth dorsally to the mid-ventral line of the ninth, and goes backward to the tip of the tail. The anterior region has eight bristle-tufts and seven uncinigerous rows. Anterior bristles in two series, an upper with long tapering tips and narrow wings, and a lower, shorter series with wings which are at first narrow, then expand into a spatulate region, and gradually cease as narrow wings on each side of the terminal filament. The succeeding region of the body has only bristles with narrow wings, the tapering tips having a distinct curvature. The tips are much elongated toward the tail, and in many of these the wings are not distinguishable. The long anterior hooks are much tapered inferiorly, increasing in diameter to the shoulder, which gently diminishes to the stout neck. The main fang leaves the throat nearly at a right angle, and on the crown above it are five or six teeth. Posterior hooks in a single row with a convex anterior and a concave posterior outline. Main fang leaves the throat at less than a right angle and is strong and sharp, with four or five teeth above it. The base or shaft is stunted with a slight flexure backward.

SYNONYM.

1916. *Chone Reayi*, McIntosh. Ann. Nat. Hist., ser. 8, vol. xvii, p. 43.

Habitat.—Between tide-marks, St. Peter Port, Guernsey, under red ascidians; attached to stones, between tide-marks, Herm, along with *Sabella B.C.*; Galway (E. P. Wright); 80 fathoms, St. Magnus Bay, Shetland (J. G. Jeffreys). Abroad it extends to Canada, Greenland, and Finmark.

¹ Named in honour of Lord Reay, K.T., LL.D., who since his Rectorship of the University has interested himself in the scientific marine work at St. Andrews, and who felicitously opened the Gatty Marine Laboratory in a great assembly in 1896.

The *cephalic plate* has a thinner but fuller collar than in *Chone Fauveli*, and its edges are turned in dorsally, sloped inward and backward, to be fixed to the first segment on each side of the middle line and to the sides of the groove in front, but its anterior margin is well behind the free edge of the collar above, and no continuation of this part occurs in front—a distinctive feature with such as *Chone Duneri* and others. As in the former species and in *C. Princei*, the fissure presents a pouch at the attachment of the collar posteriorly. The collar passes with a slightly crenate margin nearly straight to the ventral surface, but, from attachment, the free rim is there narrow. In this species the bases to which the branchiæ are attached are different (Plate CXXXI, figs. 1e and 1f), for they form two semicircular, soft grooved lobes which do not project beyond the margin of the collar in lateral view. To the inner (median) or straight edges the cirri are attached, and the whole base is constricted posteriorly, so that it is mushroom-like. There is no bifid process of the lip-membrane as described by Southern in *Chone filicaudata*.

Each branchial filament has a large camerated, chordoid axis, which extends into the elongated terminal process as a fine thread. The long pinnæ arise in a double row and continue to the base of the terminal process, the sides of which have a series of short pinnæ, giving a character to the organ, and which gradually diminish, leaving a smooth, subulate process (Plate CXXXI, fig. 5), much shorter than in *Chone Duneri* and of a different character. As a transparent object, the filament shows a series of rounded areas inside the chordoid axis, which probably represent the bases of the pinnæ. Few species show the structure of these organs more clearly.

The *body* is shorter and smaller than in *C. Fauveli*, the largest example being fully an inch in spirit, and having about fifty-five segments, of which eight bristled are anterior. It is rounded throughout the greater part of its extent, especially dorsally, and only at the posterior third is the ventral surface flattened as it tapers to the tail, the tip of which projects as a special process with an oblique end—the slope of the anus being from above downward and forward. A little pigment occurs dorsally and ventrally at the tip, which in a small example had a minute filiform process, so that *C. filicaudata* is not the only form so provided. From the dorsal fissure at the collar a groove runs backward in the middle line to the end of the seventh bristled segment, then slants to the right across the eighth dorsally and the ninth ventrally to the middle line at its posterior border, and thence backward to the tip of the tail. The segments show a few transverse lines, but only a few of the anterior ventrally are distinctly divided into two rings. The anterior region has eight bristle-tufts and seven uncinigerous rows.

The first bristle-tuft consists of simple bristles, but the second and those following in the anterior region are of two kinds, viz., a dorsal series of translucent bristles, with a pale golden sheen when viewed under a lens, and long tapering tips, with very narrow wings (Plate CXXX, fig. 1), which disappear before reaching the extremity, and of a spatulate ventral series (Plate CXXX, figs. 1a and 1b), with cylindrical shafts, the tips of which project a little beyond the surface, and end in a delicate filament. The wings are at first narrow, expand into a spatulate region, then gradually cease as a narrow rim on the base of the terminal filament. The prolongation at the tip distinguishes this bristle from the corresponding form in *C. Fauveli*. The succeeding region of the body has only the narrow winged tapering bristles which, as in front, have a distinct curvature. Toward the posterior end the bristles elongate

and are directed downward and backward, or just in front of the tail, downward and forward. In these elongated bristles the wings are indistinguishable. A few shorter bristles, probably in process of development, occur in these tufts.

The striated shafts of the long anterior hooks (Plate CXXX, fig. 1*c*) are even more tapered at the insertion than in *C. Fauveli*, and they increase in diameter upward to the shoulder, which gently diminishes to the stout neck. The main fang leaves the throat nearly at a right angle, and on the crown above it, in lateral view, are five or six teeth. The neck and shoulder of these hooks have a forward curve, so that the head is carried backward. The posterior hooks (Plate CXXX, fig. 1*d*) have a convex anterior and a concave posterior outline, but the base is not bent backward as in the ordinary avicularian forms. The main fang leaves the throat at somewhat less than a right angle and is strong and sharp. Above it is a series of four or five or more small but distinct teeth. The slightly curved neck dilates a little as it merges into the stunted shaft or base, which has a slight flexure backward, the character of the hook being thus diagnostic and different from those of species of *Chone* hitherto described. In a variety from Finmark the bases of these hooks are tapered into shaft-like processes, and the whole series forms in each foot an elegant fan. They are in a single row.

Genus CLXXIII.—JASMINEIRA, *Langerhans*, 1880.

Characters as in the Family, only the anterior region has single rows of long hooks, whilst the posterior region has avicular forms as in *Sabella*. The collar is like that in *Euchone*, but the ventral median curves are less marked, though longer. Langerhans places the genus near *Dialychone*, Claparède, though the posterior hooks of that genus approach those of the Terebellids, whereas in *Jasmineira* they resemble those of Sabellids. Along with *Bispira*, *Dasychone* and *Laonome* it forms an intermediate group between that of *Sabella* (*Spirographis*, *Branchiomma*, *Potamilla* and *Sabella*) and the *Chone*-group (*Euchone*, *Chone*, *Dialychone*, *Oria*, *Fabricia*, *Leptochone* and *Myxicola*).

1. JASMINEIRA ELEGANS, *De St. Joseph*, 1894. Plate CXXIX, figs. 4—4*e*—bristles and hooks.

Specific Characters.—Cephalic lobe, on removal of the branchiæ, has a mushroom-shaped base streaked longitudinally and split in halves. From the ventral edge of each half three to four slender, smooth cirri project. Collar well-marked, with a dorsal fissure, but an entire ventral edge. Linear eyes on the fused buccal and first segments, and two otocysts (De St. Joseph). On the dorsal region of the mouth are two short conical, ciliated appendages (antennæ of Pruvot and Meyer rather than two large palps), and having a green vessel (De St. Joseph). Branchiæ eight to twelve (De St. Joseph) on each side, with a double row of ciliated barbules, and a naked process with a thickened base at the tip of each filament. They are tinted green by the blood-vessels and dotted with red pigment-specks. The *body* in spirit has the outline of *Chone* and is little tapered till the posterior third (in the living form it tapers from the collar to the posterior end),

which has an acute tip with a conical papilla above the anus. Anterior region of nine segments, the posterior of twenty-five to thirty-one. The ventral groove cuts through the right edge of the eighth ventral scute (glandular area) in its progress to the dorsum. Two small scutes begin the series on the second bristled segment, and the next seven rather increase in size from before backward. The scutes of the posterior region are in pairs, separated by the broad ventral groove. Colour pale yellow or pale brownish throughout, the branchiæ being slightly deeper in tint when contracted. Two large dark patches like eyes occur on each side beneath the collar. Dorsally the alimentary canal appears as a moniliform pale orange band with dark masses at the sides. It is pale posteriorly. At the margin of the third and fourth segments the body is encircled by a fine greyish refringent line.

Anterior region with nine bristle-tufts, the first near the posterior border of the fused buccal and first segments. It consists of capillary bristles with curved and winged tips. The other tufts of the region have in addition bristles with a spatulate tip and a central process. Bristles of the posterior region of one kind, viz., capillary with tapering, winged tips, which, however, have a tendency to increase in length even at the anterior part of the region, but toward the tail have remarkably long, hair-like tips. Anteriorly the bristles are dorsal, posteriorly ventral to the hooks. Anterior long crotchets are in a single row, each curved like a bow, the striated shaft dilating gradually upward from the slender base to the shoulder; then follows a somewhat narrower smooth neck, from which the main fang comes off nearly at a right angle, the crown above having numerous small teeth. The hooks in each row number from nine to twenty. Posterior hooks **S**-shaped, the base smoothly curved anteriorly, convex inferiorly and turned upward posteriorly. Neck slightly constricted, the main fang, which is long and sharp, coming off at less than a right angle and having numerous small teeth on the crown above. Probably tubicolar amongst oysters.

SYNONYMS.

1894. *Jasmineira elegans*, De St. Joseph. Ann. Sc. nat., 7^e sér., t. xvii, p. 316, pl. xii, figs. 337—346.
 1900. „ „ Newbigin. Communic. Millport Stat., i, p. 1.
 1902. „ „ Fauvel. Comp. Rend. Acad. Sc. Paris, December 29th, 1902.
 1909. „ „ idem. Ann. Sc. nat., 9^e sér., t. x, p. 210.
 1910. „ „ Southern. Proc. Roy. Irish Acad., vol. xxviii, p. 242.
 „ „ „ Elwes. Journ. M. B. A., vol. ix, p. 65.
 1914. „ „ Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 140.
 1915. „ „ Allen. Journ. M. B. A., vol. x, p. 643.
 „ „ „ Southern. Irish Sc. Invest., No. 3, p. 49.
 1916. „ „ McIntosh. Ann. Nat. Hist., ser. 8, vol. xvii, p. 45.
 1917. „ „ Rioja. Anél. Poliq. Cantáb., p. 71.

Habitat.—Clew Bay, two miles east of Bailey Light, Dublin Bay, and West coast of Ireland, 13—16½ fathoms (Southern); Millport, Cumbræ (Newbigin); Torquay (Elwes); Asia Shore, Plymouth (Allen). Elsewhere it is found off Norway; dredged amongst oyster-shells and probably tubicolar at Dinard, France (De St. Joseph); shores of Cantabria (Rioja); St. Vaast-la-Hougue (Fauvel).

The *cephalic lobe*, when the branchiæ are removed, projects as a mushroom-shaped basal region—that is, it is constricted proximally and dilated distally, with a median cleft,

and marked externally by lines or grooves. From the ventral edge of each half three or four slender, smooth cirri (four to six, De St. Joseph) project. A well-marked collar is present with a dorsal fissure as in *Chone*, and an entire ventral margin. De St. Joseph describes linear eyes on the fused buccal and first segment, but these were not observable in the spirit-specimens. The number of the branchiæ is from eight to twelve on each side and they show two chordoid cells in transverse section. They have a double row of ciliated barbules, and terminate in a naked process with a thickened base.

De St. Joseph observes that the foregoing fused segments have, besides the eyes, two branchial hearts, two red thoracic organs debouching by a common canal at the base of the branchiæ dorsally, and two otocysts with trembling otoliths. Fauvel,¹ however, states that in the closed otocysts, to which group those of *Jasmineira* belong, the "trembling" is due to Brownian movement only, as there are no cilia.

The *body*, which in spirit is about an inch in length, has the outline of *Chone*, and is little tapered before the posterior third. It ends in a slender tip with a conical papilla above the anus. The anterior region consists of nine segments, the posterior of twenty-four or twenty-five segments or even more (De St. Joseph gives a total of forty). The ventral groove cuts through the right edge of the eighth ventral shield in its progress to the dorsum. The ventral shields commence anteriorly by two small ones, and the next seven, which are entire, rather increase from before backward. The scutes of the posterior region are in pairs, being distinctly separated by the broad ventral groove. Diminishing in size they become invisible on the minute terminal segments. The first bristle-tuft is small and occurs near the posterior border of the united buccal and first segments. It consists of simple, but by no means feeble bristles, the shaft being a little diminished at the neck, so that the slightly curved tip with its narrow wings and acute point is clearly differentiated (Plate CXXIX, fig. 4). Nine bristle-tufts occur anteriorly. They consist of two kinds, viz., winged capillary bristles with the slightly curved and acutely tapered tips (Plate CXXIX, fig. 4a), and spatulate forms (Plate CXXIX, fig. 4b), the wings of which rapidly dilate, terminate abruptly, and have a short median process, often bent. The bristles of the posterior region, which are below the hooks, are of one kind only, viz., the simple, winged, tapering forms, but the tips have even in the first part of the region a tendency to elongation, and towards the end of the tail the tips, (Plate CXXIX, fig. 4c) are extremely attenuate so as to resemble fine hairs, though the narrow wings can generally be noticed at the end of the shaft. The distinctions in this respect had not been observed by De St. Joseph.

The anterior crotchets (Plate CXXIX, fig. 4d) have long, curved shafts commencing as narrow bases, but gradually dilating to the shoulder, which continues the curve and is narrower than the adjoining part of the shaft. The neck is not constricted and the main fang leaves it nearly at a right angle, whilst on the crown are numerous small teeth. The whole crotchet has the curvature of a bow. De St. Joseph speaks of nine crotchets only, but occasionally about twenty are present, and since their narrow bases occupy a comparatively small area, the group has the form of a fan, the broad tips requiring more space for the action of their armature. The hooks of the posterior region differ from those of *Chone* and *Euchone* and more resemble the type in the Sabellidæ. They are characteristically S-shaped (Plate CXXIX, fig. 4e), the base being smoothly curved anteriorly, convex inferiorly

¹ Op. cit.

and turned upward posteriorly. A slight constriction occurs at the neck, from which the main fang comes off at less than a right angle and is long and sharp, whilst on the crown above are numerous minute teeth. The posterior outline bends forward at the crown, then backward, and with a bold forward curve in the main part of the body. The differences between this species and *J. caudata*, Langerhans, which Mr. Southern procured in Clew Bay, seem to be slight, mainly the elongated caudal process, as in the form procured at Madeira by Langerhans.

The arrangement of the bristles and hooks in such a type is well seen in transparent preparations of a young form.¹ The first pair of bristle-tufts differs from the succeeding in having no spatulate forms, which appear in the second tuft, the ventral region of which has eight long hooks; the third has also eight long hooks, whilst the fourth has only six and fewer bristles. The fifth and sixth each have six hooks; the seventh has four, the eighth four on one side and five on the other, and there the thoracic region ends. The next segment has no spatulate bristles, and the hooks are avicular. Both the finely tapered curved bristles and the diminishing hooks continue to the posterior end.

Reproduction.—De St. Joseph found the males whitish from the sperms, whilst the females were greyish or brownish from the eggs. A female of 7 mm. carried eggs—indeed all his examples seem to have been smaller, 12—18 mm., than the British. The French author found Gregarines and Cytodes with parapodia in the intestine, together with encysted Gregarines, and from the presence of two denticles he thought the two Gregarines pertained to the genus *Pachysoma*, Mangazzini.

Lo Bianco (1909) gives August and September as the period of sexual maturity in *Jasmineira candela*, and it is probable the British form would not differ much except in being somewhat later. Southern found mature specimens in May, August and September.

2. *JASMINEIRA CAUDATA*, Langerhans, 1880. Plate CXXXVIII, fig. 5—anterior hook; fig. 5a—posterior hook.

Specific Characters.—The collar appears to be higher and not so oblique as that of *J. elegans*. Two oblong red eyes and a pair of statocysts in the second segment. Body with seventeen abdominal segments, whereas *J. elegans* has twenty-eight to thirty-two. A caudal appendage.

SYNONYMS.

1880. *Jasmineira caudata*, Langerhans. Zeitschr. f. wiss. Zool., Bd. xxxiv, p. 114, Taf. v, fig. 32.
 1914. „ „ Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 140.
 1916. „ „ McIntosh. Ann. Nat. Hist., ser. 8, vol. xvii, p. 47.

Habitat.—Clew Bay, 17 fathoms (Southern). Elsewhere it occurs at Madeira (Langerhans).

The posterior hooks (Plate CXXXVIII, fig. 5a) of this form are smaller and less curved than those of *J. elegans*, and the process at the base posteriorly is perhaps less

¹ I am indebted to Major Elwes for these and other interesting forms from the southern shores.

distinct. The specimen is considerably smaller than the average size of *J. elegans*, but is most closely allied, and intermediate forms may yet be found. It is mature in May (Southern).

Langerhans gives a brief account of this species as having the first segment unarmed, with large blood-vessels and two oblong red eyes. Collar with only a dorsal median slit and somewhat higher than in *J. elegans*. The second segment has a pair of otocysts with rounded otoliths and a dorsal tuft of winged bristles. From the third to the ninth segment the dorsal bristles are winged. Ventrally the long hooks are narrowed above the shoulder, with three teeth above the main fang (Plate CXXXVIII, fig. 5). There are seventeen segments in the abdomen with ventral bayonet-shaped bristles, whilst dorsally are avicular hooks, the figure being somewhat elongated and the main fang making an acute angle with the neck. Southern, again, could find no difference between the bristles (and hooks ?) of this form and *J. elegans*, the presence of a caudal appendage alone distinguishing *J. caudata*.

Genus CLXXIV.—MANAYUNKIA, *Jos. Leidy*, 1858 (HAPLOBRANCHUS, *A. G. Bourne*, 1883).

Cephalic region consisting of pro- and peristomium almost fused; two prostomial tentacles; two palps with a blood-vessel; collar slightly developed. Body minute, nearly cylindrical, though slightly tapered posteriorly where the anus opens a little within the tip. Two "branchial" stems, each dividing into four simple, free filaments, richly ciliated, but devoid of blood-vessels. Tubiparous glands separate. Sexes distinct.

1. MANAYUNKIA (HAPLOBRANCHUS) ÆSTUARINUS, *A. G. Bourne*, 1886. Plate CXVII, figs. 3 and 3a—body and anterior region; Plate CXXXV, figs. 20 and 20a—bristle and hook.

Specific Characters.—Cephalic region as in the genus, the palpi having green blood, but the filaments of the branchiæ are pale. The palps are inferior, the branchiæ superior. Two eyes on the dorsum. Body 4—6 mm. long, nearly cylindrical, but tapered a little posteriorly. Anterior region of eight setigerous segments, posterior region of three bristled segments. Anterior bristles simple, winged, tapering. Posterior bristles also with wings, but the ventral forms have longer tips. Anterior hooks ventral, with broad crowns and rather long curved shafts. Posterior hooks dorsal, with larger crowns and straighter shafts. In tubes of sandy mud.

SYNONYMS.

1883. *Haplobranchus æstuarinus*, *A. G. Bourne*. Quart. Journ. Micr. Sci., vol. xxiii, p. 169.
 1910. " " Southern. Proc. Roy. Irish Acad., vol. xxviii, p. 242.
 1915. " " Allen. Journ. M. B. A., vol. x, p. 643.
 1916. " " McIntosh. Ann. Nat. Hist., ser. 8, vol. xvii, p. 47.

Habitat.—Coast of Sheppey (*Bourne*). In mud from the mouth of the Liffey (*Bolton*).

Cephalic region furnished with two short prostomial tentacles which have pigment, whilst the base is united with the palps, and the peristomial tentacles, which have a continuation of the body-cavity, and these organs are richly ciliated on their inner faces. The palps

are long, richly ciliated dorsally, and have a large green blood-vessel. A pair of eye-spots occur at the side of the prostomium. The collar is formed of the peristomium. The mouth is between the palps and the bases of the peristomial tentacles.

The *body*¹ has twelve segments, of which nine form the anterior and three the posterior region. The segment behind the peristomium bears dorsal capillary bristles only, viz., forms (Plate CXXXV, fig. 20) with long tapering winged tips, and shorter forms with broader and shorter wings, which are said to occur only on one side of the axis. The next segment also has dorsal capillary bristles, but in addition ventral crotchets (Plate CXXXV, fig. 20a), which have short, curved shafts and rather broad serrated tips. In the posterior region the hooks are dorsal and the bristles ventral in position. The bristles are more slender and longer than the anterior, with winged tips.

The alimentary canal is comparatively simple, being cylindrical in front, constricted in front and rear, has an ovoid swelling in the fifth bristled segment, and then diminishes till it reaches a rectal enlargement. It is ciliated posteriorly, and anteriorly has brown pigment in its walls. The blood is green, and the dorsal vessel is bifurcate anteriorly and posteriorly before joining the ventral vessel. In the tenth and eleventh segments a trunk connects the dorsal and ventral vessels, and in the females similar trunks occur in the fourth and fifth segments. Vessels also probably form a sinus around the intestine in the central region of the body. Trunks enter the head and dilate into a sinus at the base of the peristomial tentacles as in allied forms (*e.g. Fabricia*). Paired bodies (probably segmental organs) occur in the segments 10—12 at the bases of the feet. In the third are two bodies which may be these organs modified to perform the functions of tubiparous glands, and they open at the bases of the feet.

Reproduction.—The sexes are distinct, the sperms in various stages of development floating in the body-cavity of segments 7—9, and they are confined to the central region by a membrane. The “spermatospheres” are elongated rope-like bodies. Ova are found in segments 4 and 5, and are large. They probably escape by rupture of the body-wall.

Bourne (1883) considered that this form pertained to the Serpulidæ from its capito-branchiate nature, but differed in so far as the branchial tentacles are devoid of any secondary filaments or any trace of “cartilaginous” support. It agrees with the Sabellidæ in the “absence of any thoracic membrane and operculum.” It agrees with *Amphiglena*, *Fabricia* and *Amphicorina* in the modified segmental organs of the second segment. There is no trace, however, of auditory capsules or caudal eyes. They all agree with *Manayunkia* in the simple structure of the head, in which the prostomium is not completely fused with the peristomium, and presents prostomial tentacles and palps. The peristomial collar, completely absent in *Amphiglena*, is only slightly developed in the other forms. Prof. Bourne had some doubt about the palps, and their blood supply would lead one to attribute to them a respiratory function. He likens the tentacles to the dorsal and ventral divisions of the foot, and thought they might be peristomial, but De Quatrefages states that the branchiæ of the Serpulidæ receive their nerve-supply from the supra-oesophageal ganglion and consequently they are prostomial. “Claparède and Mecznirow have, however, shown that in *Dasychone lucullana* they are peristomial.”

¹ I am indebted to Mr. Shrubsole for aid in procuring examples *per* Mr. Bolton.

When Sir A. G. Bourne published his account of *Haplobranchus*, Dr. Leidy's papers¹ on *Manayunkia speciosa* were not alluded to, but it was thought that there might be a close connection between the American and the British forms. Further examination shows that this supposition was correct. Thus the body in both consists of twelve segments, including the "head," the cephalic region having in *Manayunkia* two stems, Leidy's "lophophores," each with eighteen ciliated brownish "tentacles," the two inner larger than the others and supplied with green blood. Two eyes lie at the side of the gullet and present "vitreous humour and a choroid capsule." *Haplobranchus*, again, has only four filaments projecting from the stem with the green "palpi" internally, but the plan of structure is the same, and the blood in each is green and enters the "palpi" only. A large vessel occurs in *Manayunkia* on each side of the alimentary canal so as to give it a green coat, and a lateral branch is given off in each segment. There is an incessant pumping of blood into the "palpi" and contraction and expulsion from them. The intestinal canal is ciliated in the seventh segment and at the posterior end. A large elliptical organ extended from the posterior part of the head to the third segment and Leidy thought it a testicle. It probably is the modified segmental organ seen in the third segment of *Haplobranchus*, and the American author's ovaries in the fourth to the sixth segment (inclusive) may represent the paired bodies mentioned by Bourne as occurring in the tenth to the twelfth segments at the base of the feet, though this is conjectural. Leidy found young ones in the tubes of mud and he thought the young were developed there. Moreover the tubes were sometimes branched like a candelabrum on pieces of bark in Egg River, New Jersey, for, like *Haplobranchus*, it is a fresh-water form. On the other hand *Haplobranchus* lives amidst the mud. The hooks and bristles of the two forms closely correspond, so that on the whole the generic name *Manayunkia* should stand, though Sir A. G. Bourne's title and the excellence of his descriptions and figures have due weight. The increase of the divisions of the prostomial stems in the American form is a prominent feature. Dr. Leidy considered that *Manayunkia* was closely related to *Amphicora fabricia*, though in the latter the blood is red.

SUB-FAMILY.—ERIOGRAPHIDEA, *Malmgren*.

The Eriographididæ of Malmgren may be conveniently regarded as a sub-family of the Sabellidæ. The structure of the body-wall, for instance, is not more remarkable than that found in *Chone* and *Euchone*, and there is no apparent advantage in continuing the isolation of the group.

Genus CLXXV.—MYXICOLA, *H. Koch* (*fide* Grube and Claparède).

Myxicola, Grube (1855) and Sars; *Eriographis*, Grube; *Arippasa*, Johnst., 1865; *Leptochone*, De Quatrefages and Levinsen; *Gimnosoma*, De Quatrefages.

Cephalic plate devoid of a collar; triangular plate passes forward in the mid-dorsal region between the branchial fans and another ventrally. Two short tentacles. Closed

¹ 'Proc. Nat. Sc. Philad.,' 1858, p. 90, and 1883, p. 204; pl. ix, figs. 1—24 (1884).

statocysts. Branchiæ forming a half circle on each side, not caducous like those of *Sabella*, connected by a web almost to the tip, each filament with a webbed, flattened and tapering terminal process, sometimes enlarged at the base. No eyes. Body of two regions, round, somewhat fusiform, highly contractile. Ventral sulcus passes backward to the eighth segment cutting it obliquely as it goes to the right to end dorsally about the middle of the ninth. Anterior region of eight segments. First segment sends forward a short triangular process. Two segmental organs in the anterior region opening by a common duct on the dorsum. Bristles with finely tapered though rather short tips and narrow wings. They are both more slender and more minute posteriorly. Anterior region with rows of long crotchets. Posterior hooks forming a transverse series from the dorsal to the ventral surface, small, avicular, with a main fang and above it a comparatively large tooth. No ventral scutes or shields. Tube of mucus. The representatives extend to America (Verrill) and to the Antarctic Ocean.

It is curious that no example of this genus was procured by the "Challenger," its representatives perhaps being chiefly littoral or confined to comparatively shallow water.

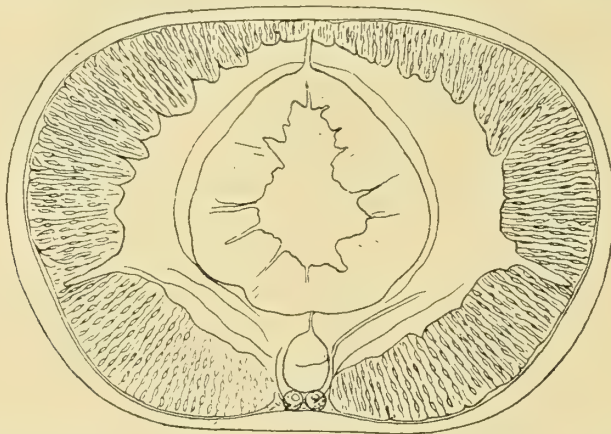


FIG. 162.—Transverse section of the body-wall of *Myxicola infundibulum* in the anterior region.

In *Myxicola infundibulum*, which Malmgren placed under the Eriographididæ, the thin cuticle covers a hypoderm of considerable thickness which is directly fixed to the circular muscular layer surrounding the body beneath it and passing external to the nerve-cords. The dorsal longitudinal muscles are lappet-shaped, that is, narrowed on each side of the mid-dorsal line, which is occupied by the short mesentery supporting the alimentary canal, and enlarging in their progress to the lateral region. The ventral longitudinal muscles are of similar shape, and are separated in the middle line in the interganglionic areas by the small, rounded nerve-trunks above which is the large median (ventral) blood-vessel, which also lies between the upper edges of the ventral muscles. In transverse section both dorsal and ventral muscles are pennate. Anteriorly the wall of the alimentary canal is highly vascular, large blood-vessels being distributed on its surface. When a ganglion is cut the space between the ventral muscles is larger. Externally to the nerve-trunks is the circular muscular coat, the hypoderm and the cuticle, and a small neural canal is present superiorly in each nerve-trunk. The slender oblique muscles appear to be attached over the nerve-trunks. The trunks fuse posteriorly, and have a single median neural canal superiorly. The close proximity of the large ventral blood-vessel to the nerve-trunks is noteworthy,

as is also the great size of the vessels generally (Fig. 162). In this region a chloragogenous mass envelops the vessel above the nerve-cord, and in transverse section forms a compact, brownish, bilobed mass with the vessel in the centre (Fig. 163).

The contraction of the powerful longitudinal muscles, especially posteriorly, causes the soft hypoderm to assume regular wrinkles (Fig. 164), as well as throws, with the aid of the

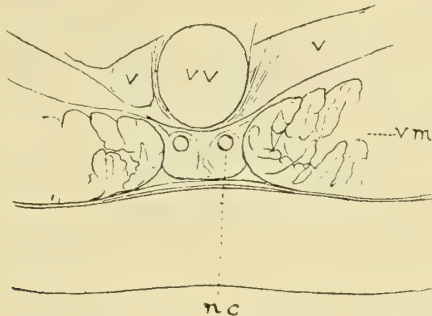


FIG. 163.—The nerve area of *Myxicola infundibulum*, more highly magnified. *nc.*, neural canals; *vv.*, large ventral blood-vessel.

septa, the alimentary canal into deep folds. In this section the massive muscles of the body-wall are clearly shown. On the whole the muscular investment anteriorly is more massive than in *Sabella*, and the finely pennate condition is a special feature.

Claparède, Meyer and De St. Joseph have more or less gone into details of the structure of the body-wall, the muscular, digestive, circulatory and nervous systems. De St. Joseph (1898) treats of the secretion of the tube, excretory organs, muscles and nerve-cord. Claparède in the generic characters states that uncini are absent in the anterior region of

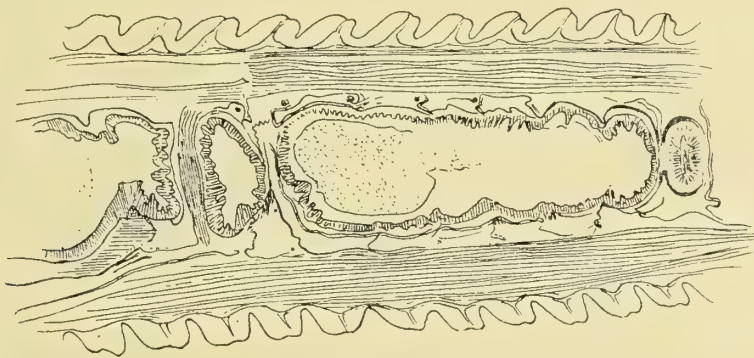


FIG. 164.—Longitudinal section of the caudal region of *Myxicola infundibulum*.

the body—probably a printer's error. Numerous interesting observations on the structure of this species were made by this author (1873). He describes the glands as distributed generally throughout the hypoderm for the abundant secretion of mucus. The segmental organs (only a pair) are much folded and pigmented as well as highly vascular. He did not connect these with the issue of the reproductive elements, which he thought were discharged at a pigmented (violet) spot above each torus. *Myxicola*, he states, is exceptional in having the longitudinal muscular layer of the gut internal—next the epithelial coat, the reverse of the usual condition in the Polychæta. The same condition was found by Claparède in *Spirographis Spallanzani*. He also thought this arrangement occurred in Chætopterids

in the "hepatic" region. In *Myxicola* the "pennate" arrangement of the muscles shows great complexity.

The circulation is similar to that in the Sabellids with certain peculiarities. In the abdominal region the sinus surrounds the gut, and from the ventral vessel a trunk passes outward to the lateral longitudinal trunk, from which again a branch proceeds upward to join, after a dorsal curvature, the intestinal sinus. Moreover in the mid-abdomen a dorsal dilatation is present at each side simulating two dorsal trunks, but this disappears anteriorly and posteriorly. The dilatation occurs where the branch from the lateral vessel joins the sinus. A coat of chloragogen covers various vessels both in this species and in *Spirographis*. Moreover in *Myxicola* the intestinal sinus has numerous nucleated bristles throughout its cavity, and Claparède thought that its wall had an inner lining of epithelium.

In the stomachal region the sinus branches out into a great vascular plexus, and, as the canal curves downward, the plexus joins a large ovoid vascular reservoir above the oesophagus and immediately behind the cephalic ganglia. The ramifications also supply what Claparède calls the duct of the tubiparous gland. In front it forms a large arc from which the branchial trunks arise.

Claparède (1873) states that a special nerve in *Myxicola infundibulum* arises from the cerebral ganglion, and describing an arc passes to the side of the body and abuts on a little fossa between the branchial apparatus and the anterior border of the thorax; such is evidently a sense organ. A similar organ exists in *Leptochone*, *Amphiglana* and *Oria*. The pair of (segmental) tubes in front secrete the material for the tube. He observed no nerves in the oesophagus of *Myxicola infundibulum*, nor did he find them in *Spirographis Spallanzani* or *Branchiomma vesiculosum* or other sedentary annelid. In the annelids the branchial artery and vein are united with each other (except in the Spionids) by a system of branches. This is antagonistic to the view of De Quatrefages, who held (though he afterwards retracted it) that each branchia had a single vessel in communication with a series of contractile ampullæ in the tissues.

The nervous system in *M. infundibulum* shows a tubular fibre with a dilated end in each cerebral ganglion and the two tubes pass backward on the dorsum of the connectives to the thoracic region, but they unite in the abdominal region to form a single large tubular fibre. It is interesting that the cords are double in front, but one gradually diminishes and disappears after the union of the tubular fibres to form the large one at the upper region of the nerve-cord.

In *Myxicola* Cosmovici (1880) is of opinion that the organ of Bojanus consists of a pair of pouches which separately debouch into the buccal funnel, and they are distinguished by their dark pigment. The segmental organs, on the other hand, occupy each segment from the middle of the body backward toward the tail, and have the form of ciliated funnels on the posterior faces of the diaphragms opening by a tube which has an aperture below the setigerous process of the foot. This differs from the observations of other authors. The ova in this form are green (as is the blood), the males being readily distinguished by their pallor.

Cunningham¹ (1888) corrects Claparède's view that in *Myxicola* only a single nerve-cord exists, and he states that the neural tubes in each oesophageal commissure become continuous

¹ 'Quart. Journ. Micr. Sc.,' N.S., vol. xxviii, p. 272.

with one another in the cerebral commissure. A single neural canal, at first (some distance behind the œsophageal ring) on the left, then becomes central, the cords being on either side of it to the posterior end of the body. He observes that the cords are completely separated from the epidermis, whilst in the Sabellids they are not so—a conclusion which differs from that shown by the author in 1877,¹ and held now.

Grube (1855) adopted the title *Myxicola* of Koch. He included it as a genus of the Sabellids, as indeed he did long before in his 'Familien' (1851).

This group was included in his family Serpulidæ by De Quatrefages (1865) and ranged along with the Sabellidæ.

Levinsen (1883) follows Malmgren in retaining this group as a separate family, and he adopts Claparède's title *Leptochone*, his only species being *Leptochone Steenstrupi*, Krøyer.

The species of *Myxicola* group themselves under two divisions, viz., those with the beaked crotchets in the longer anterior region, and those with the simply hooked crotchets in the shorter anterior region. The posterior hooks in all retain greater uniformity.

1. MYXICOLA INFUNDIBULUM, *Montagu*, 1808. Plate CXIV, fig. 4—body; Plate CXXX, figs. 4—4c—bristles and hooks.

Specific Characters.—Cephalic plate devoid of a collar; a triangular process passes forward in the mid-dorsal region between the branchial fans, and ventrally a slight projection also occurs between them. Closed statocysts. Branchiæ not caducous; filaments twenty-one to thirty-seven in each fan, connected by a web almost to the tip as in *Chone*, and having a chordoid axis, a slender continuation being carried into the terminal filament, which has a tapering web on each side and is often tinted dark purple. Pinnæ long with a chordoid axis, not jointed, and they taper a little from base to apex. Distally the pinnæ form a short alternate double row. Branchial plumes of a rich dark chocolate brown, the pinnæ being purplish red. The bases are dull orange like the colour of the body. Body 2—10 inches in length and having 45—150 or 160 two-ringed segments, somewhat fusiform, for it is narrowed in front and tapers posteriorly; rounded throughout except anteriorly, where on the ventral surface a groove (*sillon copragogue*) passes backward to the eighth segment, which it cuts obliquely as it goes to the right and ends dorsally about the middle of the ninth. Posteriorly the body terminates in an anus at the blunt tip. It is of a dull orange hue, and in the Zetlandic specimens a white ring encircled the body in front of the third segment-junction. The anterior region has eight segments. Bristles uniform throughout with long, straight, cylindrical shafts and finely tapered though rather short tips and narrow wings slightly bent backward. Posteriorly the bristles are more minute and more slender and the shafts are tapered toward the tip, which has a curvature as in front and a trace of wings. Anterior region has groups of about eight long crotchets which somewhat resemble those of *Oligochæts*. The shaft is long, curved, tapered inferiorly, dilating at its distal third into a shoulder from which it is gently diminished to the throat. Neck stout and nearly straight; main fang arises at a wide angle to the neck, is blunt, and the crown above it, which slopes downward in lateral view, has a few small teeth. Posterior hooks

¹ 'Proc. Roy. Soc. Edin.,' Session 1876-77, pp. 11 and 12, sep. copy.

have the anterior outline curving from the main fang downward to a blunt prow, the inferior outline being slightly concave, as also is the posterior. The main fang is long and sharp and above it is a comparatively large tooth. Tube a gelatinous secretion.

SYNONYMS.

1804. *Terebella infundibulum*, Renier. Tav. Conch. Adriat., p. 13, No. 579 (*fide Meneghini*).
 „ „ *Buccina*, idem. Prosp. dei Vermi, p. 19 (*fide Meneghini*).
 1807. *Tuba divisa*, idem. Tav. di Classif., Tav. vi (*fide Meneghini*).
 1808. *Amphitrite infundibulum*, Montagu. MS. vol. Linn. Soc., pl. xx*.
 „ „ „ idem. Linn. Trans., ix, Tab. viii.
 1812. „ „ Pennant. Brit. Zool., iv, p. 89.
 1818. „ „ Lamarck. Anim. s. Vert., v, p. 357.
 1835-45. „ „ idem. Ibid., 2^e edit., v, p. 611.
 1820. *Sabella* „ Savigny. Syst. Annel., p. 80.
 1829. „ „ Delle Chiaje. Memorie, t. iv, p. 204, pl. lxii, fig. 5.
 1836. „ „ Cuvier. Règne Anim., t. iii, p. 192.
 1841. „ „ Delle Chiaje. Descriz., t. iii, p. 72, Tav. cvi, fig. 5.
 1842. ? *Sp. innominata*, Forbes. Ann. Nat. Hist., viii, p. 244.
 1843-53. *Amphitrite infundibulum*, Chenu. Illust. Conch., 11^e livr., pl. vi, fig. 4, and pl. vii, fig. 3.
 1845. „ „ idem. Bibl. Conch., t. 1^{er}, p. 247, pl. xviii, fig. 5.
 „ *Sabella infundibulum*, Johnston. Ann. Nat. Hist., xvi, p. 449.
 1847. *Tuba* „ Meneghini. Osservaz. postume Adriat., Renier, p. 52.
 1851. *Sabella* „ Sars. Nyt Mag., vi, pp. 131 and 203.
 „ *Eriographis borealis*, Grube. Fam. Annel., pp. 88 and 140.
 1853. *Amphitrite floscula*, Dalyell. Pow. Creat., ii, p. 245, pl. xxxi, fig. 9 (young).
 1855. *Myxicola infundibulum*, Grube. Arch. f. Naturges., xxi, p. 122.
 1856. „ *Grubei* and *infundibulum*, Kröyer. Oversigt. Danske Vid.-selsk. Forh., p. 9.
 1857. *Sabella infundibulum*, Koren. Nyt Mag., ix, p. 94.
 1861. *Myxicola Sarsii*, Sars. Forhandl. Vidensk.-selsk. Christiania, p. 130.
 1862. „ *infundibulum*, idem. Ibid., p. 119.
 1864. „ „ Grube. Insel Lussin, p. 89.
 1865. „ *Sarsi*, De Quatrefages. Annel., t. ii, p. 481.
 „ „ idem. Ibid., t. ii, p. 668.
 „ *Ariippasa infundibulum*, Johnston. Catal. Brit. Mus., pp. 252 and 346.
 1867. „ „ Parfitt. Cat. Annel. Devon, p. 34.
 1869-72. *Myxicola* „ Grube. Schles. Gesells., 1869-72, p. 113.
 1870. ? „ *modesti*, idem. Arch. f. Naturges., p. 350.
 „ „ *infundibulum*, Claparède. Suppl. Annél. Neap., p. 141, pl. xiv, fig. 2.
 1872. „ „ Lacaze Duthiers. Arch. Zool. Expér., i, p. 23.
 „ „ *Steenstrupi*, Malm. Annel. Göteb., p. 102.
 1873. „ „ *infundibulum*, Claparède. Ann. Sédent., pp. 19, 34, 62, 69, 73, 83, 94, 96, 97, 100, 101, 103, 117, 130-134, pls. vi and vii.
 1875. „ „ and *Steenstrupi*, Panceri. Atti Soc. Ital., vol. xviii, p. 533.
 „ „ „ Marenzeller. Denks. K. Akad. Wiss. Wien, xlix, p. 214.
 „ „ „ Marion. Rev. Sc. nat., t. iv, p. 310 (mauve var.).
 1876-7. „ „ McIntosh. Proc. Roy. Soc. Edin., p. 380.

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| 1879-80. | <i>Myxicola infundibulum</i> , | Cosmovici. Arch. Zool. Expér., viii, p. 325, pl. xxvii, fig. 1. |
| 1885. | " " | Pruvot. Ibid., 2 ^e ser., iii, p. 318, pl. xvi, figs. 5-8 (nervous system). |
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| 1887. | " " | Meyer. Mitt. Zool. Stat. Neap., vii, p. 719, pl. xxii, figs. 13-14, pl. xxiii, fig. 10, pl. xxiv, fig. 6, pl. xxvi, figs. 18-21. |
| " " | <i>Steenstrupi</i> , | Webster. U.S. Comm. F. and F., p. 750. |
| 1888. | <i>infundibulum</i> , | Cunningham. Quart. Journ. Micr. Sci., November, p. 272. |
| " " | " " | Meyer. Mitt. Zool. Stat. Neap., viii, pp. 479-587, pl. xxv, figs. 2, 21-24. |
| " " | " " | Beaunis. Rev. Sc., 3 ^e sér., xvi, p. 367 (<i>fide auct.</i>). |
| " " | <i>Steenstrupi</i> , | Cunningham and Ramage. Trans. Roy. Soc. Edin., vol. xxxiii, p. 672. |
| 1890. | <i>infundibulum</i> , | Chigi. Org. escret. Serpul., pp. 43-49, 75-76, pl. vi, pl. xii, figs. 1-7, pl. xiv, figs. 1-3 (<i>fide auct.</i>). |
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| " " | " " | Cuénot. Arch. Zool. Expér., 2 ^e sér., ix, p. 417. |
| 1893. | " " | Lo Bianco. Atti R. Accad. Sc. Nap., vol. v, No. 11, p. 79. |
| 1894. | " " | De St. Joseph. Ann. Sc. nat., 7 ^e ser., t. xvii, p. 323. |
| " " | <i>Steenstrupi</i> , | Bidenkap. Christ. Vid.-selsk. Forhandl., p. 137. |
| 1898. | <i>infundibulum</i> , | De St. Joseph. Ann. Sc. nat., 8 ^e sér., v, p. 433, pl. xxiii, figs. 241-247. |
| 1904. | " " | Journ. M. B. A., vol. vii, p. 232. |
| 1907. | " " | Soulier. Trav. Acad. Montpel., 2 ^e sér., t. iii, p. 128. |
| 1909. | " " | Moore. Proc. U.S. Nat. Mus., vol. xxxvii, p. 144. |
| 1910. | " " | Southern. Proc. Roy. Irish Acad., vol. xxviii, p. 241. |
| 1913. | <i>Steenstrupi</i> , | Hofsommer. Wiss. Komm. Meers. deutsch., Bd. xv, p. 348, pl. i, figs. 23 and 24. |
| 1914. | <i>infundibulum</i> , | Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 146. |
| 1915. | " " | Allen. Journ. M. B. A., vol. x, p. 642. |
| 1917. | " " | Rioja. Anél. Poliq. Cantáb. p. 71. |
| 1920. | <i>Steenstrupi</i> , | Eliason. Polych. Öresund., p. 79. |

Habitat.—Knightsbridge Estuary, S. Devon (Montagu); Salcombe (Mus. Leach). Occasionally in deep water, St. Andrews Bay, and brought in by the fishing boats (E.M.), in the interstices of *Filograna implexa* near the Bell Rock. In seven to nine fathoms in Bressay Sound it occurs in masses of “horse” mussels and tangle-roots. Falmouth (W. P. Cocks); Cumbrae, Firth of Clyde (D. Robertson); Plymouth (Allen); Dublin Bay and West Coast of Ireland in muddy sand (Southern). Extends to northern waters, *e.g.*, Norway, as well as to the Mediterranean. N.E. America (Moore); shores of Cantabria (Rioja).

The wide distribution of this genus, and, it may be, of the species, is demonstrated by the capture of a form by Edward Forbes in the Greek Archipelago, and by Lovén¹ on the shores of Sweden and the North Cape. Leach, in his collections in the British Museum, termed it *Amphitrite infundibulum*, and in his specimens from the coast of Devon the branchiæ were of a rich purplish brown.

In *Myxicola infundibulum*, Montagu, the cephalic region differs from that of a typical

¹ 'Arsberattelse Zool. Framsteg,' 1840-42, p. 83 (Claparède).

Sabellid in the absence of a collar, for the first segment is smoothly rounded on each side to the base of the branchial fans, whilst ventrally a triangular process passes forward in the middle line below the division between the branchial fans, and dorsally a slight projection also points between the fans from the anterior end of the groove. Montagu describes the mouth as purple, whilst the lips are bordered with chestnut. Dalyell found no tentacles Malmgren's tentacles refer to the frilled processes on each side of the mouth.

The branchial fans appear to cling more tenaciously to their bases than in ordinary Sabellids, and comparatively few of the preparations are devoid of them. The filaments range from twenty-one in each fan (Shetland) to thirty-seven (South Devon), and they are connected by a web (which Claparède states is ciliated externally) almost to the tip, as in *Chone*. In structure each filament agrees in the main with that in *Sabella*, the camerated chordoid axis passing along its entire length and a slender continuation of it reaches to the tip of the terminal process, which has a tapering web on each side, and is often deeply tinted purple. The pinnæ are comparatively long and likewise have a chordoid axis (not distinctly camerated), and they taper a little from base to apex. Toward the tip of the filament the rows of pinnæ terminate in a double series of papillæ, which, like the pinnæ, are alternate. The branchial plumes are of a rich dark chocolate brown in life, the brown being chiefly confined to the filament externally, and the pinnæ, which are capable of independent motion, are of a rich purplish red. The bases externally, however, are of the colour of the body, viz., a dull orange. The two branchial fans are often separated to their bases during the movements of the animal. Montagu describes them as singularly beautiful and of a purple colour, darkest at the tips of the rays, and the pinnæ of a chestnut colour shaded to purple near the centre. In the Zetlandic specimens, 2 or 2½ inches long, the body had the diameter of an ordinary goose-quill, the branchial fan measured about half an inch antero-posteriorly, but when the fans were flatly extended laterally their diameter was about an inch.

The *body* (Plate CXIV, fig. 4) in the preparations is somewhat fusiform, for, besides the distinct tapering posteriorly, it is narrowed in front, and in life it sometimes assumes the same outline. It is rounded throughout except anteriorly, where on the dorsal surface a groove passes backward in the middle line to the eighth segment, which it cuts obliquely as it goes to the right, and ends ventrally about the middle of the ninth. In some, traces of the median groove are found behind the slope to the right in the eighth segment. It is of a dull orange hue throughout or in some pale, though in the Zetlandic specimens a distinct white ring encircled the body in front of the third segment-junction. Montagu mentions that the body is "of an orange-colour annulated with whitish." The number of segments varies, for Montagu gives the large southern form of 8 or 10 inches in length no less than 150 or 160 segments, whereas the smaller Zetlandic examples (of 2 or 2½ inches) had but 45—52.¹ The segments are distinct, but little differentiated dorsally and ventrally, and therein differing from the ordinary Sabellids, but they often show one or more rings—especially one ventrally near the posterior border—and in some examples a slight peak occurs at the posterior border of each near the posterior third. The segments become narrow at the tapering posterior end and terminate in a median anus at the somewhat blunt tip.

The vascular system contains greenish blood and is similar in arrangement to that of

¹ In small examples the anterior region may have fewer segments.

the Sabellids (Claparède). This author holds that a contractile sinus envelopes the intestine and he is probably right. Contrary to the view of De Quatrefages, Claparède states that the nerve-cords, double in front, are not separated behind, but form a single cord with a large neural canal (his *fibre tubulaire*), and in certain sections that canal has a larger area than the nerve-tissue, which would seem to show that the term neural canal (1879) is not out of place. In this connection it would appear to be a peculiar "giant fibre," which begins as a small tube in front and gradually dilates in its course posteriorly into a large canal.

The anterior region has eight tufts of bristles, which are of uniform structure (Plate CXXX, fig. 4), viz., long, straight, slender, cylindrical shafts and finely tapered, though rather short, tips slightly bent backward, and with narrow wings. In rear of the fascicles of bristles Claparède (1870) mentions the occurrence of a minute ocular spot—formed of a crystalline body surrounded by pigment. This has not been observed in the preparations. Posteriorly the translucent bristles (Plate CXXX, fig. 4a) are both more minute and more slender, and the shafts are tapered toward the tip, which has a curvature as in front, and a trace of a wing on each side.

The anterior region ventrally has groups of about eight long crotchets, which in general outline somewhat resemble those of Oligochaets. The shaft is long, gently curved, tapered inferiorly, dilating at its distal third into an indistinct shoulder, from which it is gently diminished to the throat below the main fang. The neck is stout and nearly straight, and the main fang, which arises at a wide angle to the neck, is blunt, whilst on the crown, which slopes downward in lateral view, are a few small teeth. Under pressure the hook often lies so as to give an antero-posterior outline (Plate CXXX, fig. 4b), which is hastate, a constriction occurring behind the great fang, from which a gradual enlargement takes place to the shoulder, beneath which it again tapers to the base. The usually acute Claparède had overlooked these organs. The terminal hook of the row shows a more simple form—without spikes in the crown. The posterior hooks (Plate CXXX, fig. 4c) are large and avicular, and identical with the type as figured by Malmgren. They have a base much produced in front, the anterior outline of the neck curving from the main fang in a convex manner downward to a blunt prow, the inferior outline being slightly concave, as also is the posterior outline. The main fang is long and sharp, and above it is a comparatively large spike. The forward projection of the prow approaches that of the Polycirrids, but the great size of the secondary tooth differs.

Reproduction.—Claparède (1870) figures both sperms and ova, but he does not allude to the month in which they occur.

The figure of this species in Montagu's MS. volume (1808) in the Linnean Society is an exquisite picture from life, and worthy of the experienced touch of his niece, Miss D'Orville.

Tube.—Montagu described the tube as entirely gelatinous, greenish on the surface, though ordinarily marked by the particles of the ground it inhabits. It is secreted in various hyaline strata, but, not as Claparède thought, by the segmental organs opening by the single aperture on the dorsum anteriorly. He further thought that the cilia on the exterior of the branchial web had an important influence on the distribution of the secretion for the tube, which, Dalyell stated, was once and a half the diameter of the body, and exceeded its length.

The figure of "*Sabella infundibulum*" given by Delle Chiaje (1829) in his "Memorie," Plate LXII, fig. 5, is more in accordance with this species than any other—both in regard to annelid and tube, and his description bears this out.

Dalyell (1853) placed an example in a short glass tube which it filled with the secretion, and in time the jelly projected beyond the mouth of the tube. When the annelid rose upward the jelly projected nine lines above the orifice of the vessel. The animal reverses itself in the tube, and sometimes it forms an additional orifice above. He describes it as timid.

Parasites.—M. Sars¹ (1861) found an ecto-parasitic Copepod, which he termed *Sabellacheres gracilis*, attached to the skin of this species. The body of the female is somewhat elongate, linear, subcylindrical, obscurely segmented, or, it may be, unsegmented. Head elongate, not separated from the thorax, with two short antennæ of few articulations, and a short conical rostrum. Three pairs of thoracic feet—widely separated, two being anterior, the third in the middle of the body, all natatory, triarticulate and biramose. Abdomen small, triarticulate. Ovigerous sac large, single, dorsal, cylindrical, and almost continuous with the posterior end of the body. Male unknown.

This in all probability is the *Myxicola Steenstrupi* of Krøyer,² though the description is so lax that it is difficult to be certain. He did not observe the hooks. Krøyer's³ (1856) four species may yet be found to refer to the present form, viz., *M. infundibulum*, *M. Grubii* from the Mediterranean, *M. Sarsii* from the North Sea, and *M. Steenstrupi* from Farøe and Greenland. Claparède thought the first two certainly were identical.

De Quatrefages (1865) did not consider Montagu's species occurred on the shores of France, and therefore he gave a new name to that which he found. As Claparède has pointed out, the French author had misunderstood Montagu's description, for the common species occurs both in the Channel and the Mediterranean as well as elsewhere.

Pruvot⁴ (1885) figures the "giant fibre" in the nervous system of this species as four or five times the size of the nerve-trunks below it.

Cunningham and Ramage (1888) apparently considered *Myxicola Steenstrupi*, Krøyer, a different species from *M. infundibulum*, but, so far as known, it is the same form.

So far as can be observed from the description and drawings, *Myxicola conjuncta* of Miss Bush⁵ (1908) agrees with this species in structure and in coloration. She attributes long setæ with simple, curved tips to *M. Steenstrupi*, which she procured from the Bay of Fundy, but the European authors are inclined to unite this species with the present.

From the description and figures of Hofsommer (1913) his *Myxicola Steenstrupi* would appear to agree with *M. infundibulum*.

MYXICOLA A.

A *Myxicola*, procured between tide-marks, Herm, in 1868, offers certain peculiarities distinguishing it from *M. infundibulum* and *M. viridis*, as well as *M. Dinandensis* of De

¹ 'Forhandl. Vidensk.-Selskabet, Christ.,' p. 142.

² 'Oversigt Kgl. danske Vidensk. Selsk. Forhandl.,' 1856, p. 35.

³ *Ibid.*, 1856, p. 35.

⁴ 'Archiv Zool. Expér.,' 2^e sér., t. iii, pl. xvi, figs. 7 and 8.

⁵ 'Tubic. Annel. Pacific,' p. 217, pl. xxvi, figs. 1—4a, pl. xxxviii, figs. 1—11.

St. Joseph, though the absence of anterior hooks leaves a margin of doubt in relation to the last mentioned. It is a small form, measuring about $\frac{3}{4}$ inch in total length, and having the typical condition of the cephalic region. The branchiæ are of moderate length, and have broader wings and less tapered tips on the distal processes of the filaments than in *M. infundibulum*.

The anterior region seems to be short as in *M. Dinandensis*, which has only three segments, and in the specimen from Herm the long crotchets appeared to have only a single tooth above the main fang as in *M. viridis*. The posterior hooks came far forward, and in structure they differed from those of their allies, for the main fang is proportionally larger and the tooth above it is only about half its length, and thus contrasts with the condition in other forms. The basal region has a nearly straight inferior border, to which the prow curves downward.

Whether this is an example with the anterior region in course of reproduction or a variety is uncertain, but its features are worthy of note. It may be a young variety of *M. viridis*, since the hooks in each closely approach in structure.

2. MYXICOLA ÆSTHETICA, *Claparède*, 1870. Plate CXXX; figs. 5 and 5a—anterior and posterior hooks; Plate CXXXII, fig. 8—anterior bristle.

Specific Characters.—Cephalic plate similar to that of *M. infundibulum*. Branchiæ¹ 8 in each fan, the tips less attenuate and more broadly webbed than in the form mentioned; tentacles short and almost semilunar. Body about an inch in length, nearly cylindrical, tapered posteriorly to the vent. Dorsum has hook-like bands of dark pigment transversely arranged on each side, leaving the centre bare. Two bands of eyes occur on the first segment, whilst laterally are two reddish-violet eyes in each segment. The terminal segment has a band of six or seven eyes within its border. Several statocysts are found in the second segment containing spherical statoliths. Colour yellowish-white. First segment achetous; the three following having dorsally pale winged bristles, and ventrally peculiar long crotchets, even more like those of an *Oligochæt* than in the typical form. Thereafter the winged bristles are ventral and avicular hooks dorsal.

Mucous tubes on algæ.

SYNONYMS.

1870. *Leptochone æsthetica*, Claparède. Suppl. Annél. Neap., p. 149, pl. xiv, fig. 1.
 1875. *Myxicola* „ Marion. Rev. Sci. nat., t. iv, pp. 309 and 310.
 1893. „ „ Lo Bianco. Atti R. Accad. Sc. Nap., vol. v, no. 11, p. 80.
 1898. „ „ Soulier. Soc. Languedoc Montpell., t. ii, 2 fasc., p. 343.
 1902. „ „ idem. Annél Cette, p. 25, fig. 6 a-e; Trav. d'Institut. Zool. de Montpellier, 2 sér., Mém. 10 and 15, pl. ii, fig. 20; pls. iv, v, ix and x.
 1907. „ „ idem. Acad. sc. Montpel., 2^e sér., t. iii, p. 133.
 1915. „ (*Leptochone*) *æsthetica*, Allen. Journ. M. B. A., vol. x, p. 642.
 1917. „ *æsthetica*, Rioja. Anél. Poliq. Cantáb., p. 72.

¹ Claparède gives the branchiæ a greenish tint.

Habitat.—Plymouth (Allen).

Mediterranean (Claparède), shores of Cantabria (Rioja).

The *cephalic plate* presents the same mid-dorsal process, and the smaller mid-ventral as in the type, and the branchial filaments differ only in the more broadly webbed and shorter tips and in the absence of the deep brown coloration. Considerable variation, however, appears to exist in this respect in the genus. The number of the filaments is eight on each side, and the attenuate condition of the pinnæ differentiates them from most Sabellids proper.

The *body* is about an inch in length, slightly diminished anteriorly, more distinctly tapered posteriorly, and without terminal appendage, the eyes (about seven), which are absent in preparations, forming a semicircle within the tip.

The anterior bristles are long, pale, and slender, and it was not always easy to demonstrate the presence of the slightly winged tip (Plate CXXXII, fig. 8). They, however, keep to the type, though in a modified degree as compared with *M. infundibulum*, the winged region being short and narrow. The posterior bristles are somewhat shorter than the anterior, and the winged region at the tip is more minute.

The anterior hooks are few in number in each group, and, so far as could be observed, had simple, straight shafts, with a trace of an enlargement below the hooked tip (Plate CXXX, fig. 5). They tapered gently from the base to the slight swelling in the neck, followed by the curve of the hook at the tip. They thus differed from Claparède's figure, which would pass for the hook of an Oligochæt.

The posterior hooks (Plate CXXX, fig. 5a) had a base vertically elongate, convex at the anterior outline and nearly straight posteriorly. A single tooth occurs above the main fang.

Whilst the former species of *Myxicola* is found on a sandy bottom with *Branchiomma vesiculosum*, this form occurs with colonies of *Hydroides*.

Miss Bush's¹ *Myxicola affinis* has certain resemblances to this form, though the description and figures leave doubt. Her *Myxicola glacialis* from Unalaska Island, embedded in much mucous under and between stones on shelly sand, has long simply curved hooks like *M. æsthetica*, a species to which she does not allude.

Claparède² (1870) instituted a new genus (*Leptochone*) and species (*L. æsthetica*) for this form, which he found plentifully in the haunts of *Amphiglena* and *Fabricia* in mucous tubes on algæ, founding the distinctions on the paucity of the anterior uncini, on the shape of the posterior hooks and the semilunar "antennæ" (tentacles). He held that the form was intermediate between *Amphiglena* and *Myxicola*. He noted the peculiar form of the three pairs of anterior hooks, the absence of tori, and their replacement by an epithelium of polygonal granular cells, the cilia of the branchial fan and the filiform terminal processes the lateral eyes and the several statocysts. He describes the "cartilaginous" axis of the branchial filaments, but this term is now generally replaced by mucoid or chordoid. The *sillon copragogue* is absent.

It may be a question whether the specimens from the Channel Islands and Plymouth refer to that of Claparède, since no pigment was visible in the preparations, and Claparède's figure of the anterior crotchet differs much.

¹ 'Tubic. Annel. Pacific,' p. 218, pl. xxxviii, figs. 17—20, 1905.

² 'Suppl. Annél. Neap.,' p. 149.

3. MYXICOLA VIRIDIS, *Milne Edwards*, 1836—49. Plate CXVI, figs. 1 and 1a—body and branchiæ; Plate CXXI, fig. 4—body; Plate CXXX, figs. 6, 6a and 6b—bristle and hooks.

Specific Characters.—Cephalic region similar to that of *M. infundibulum*. Branchiæ form a green spiral mass in repose, and a double fan in expansion of nine or ten or even fourteen filaments, each with a chordoid axis, and a strap-like terminal process, which abruptly tapers to a short terminal filament. Slightly banded with seven bars. Body of about forty-seven segments—eight anterior and thirty-nine posterior, tapered posteriorly to an anal papilla. Colour rich green, the central intestine being darker. Anterior bristles most conspicuous, and the first pair is directed forward and outward. Bristles slender, translucent, with finely tapered tips and narrow wings. The posterior bristles are smaller, and many present a curvature at the commencement of the tip. Anterior hooks in groups of five or six, long, f-shaped. Main fang leaves the long and nearly straight neck almost at a right angle, and is short and sharp. A single prominent tooth occurs on the crown above it. Typical posterior hook minute, with a long, sharp main fang, and a tooth almost as long above it. Posterior outline nearly straight; short base directed forward.

SYNONYMS.

1836—49. *Sabella à sang vert* (Milne-Edwards), Cuvier. Illust. Edit., pl. 1 c, fig. 2.¹

1843—53. ? *Amphitrite viridis*, Chenu. Illust. Conch., 11^e livr., pl. vi, fig. 1.

1874. *Sabella viridis*, McIntosh. Ann. Nat. Hist., ser. 4, vol. xiv, p. 206.

1875. „ „ idem. Invert. and Fishes St. Andrews, p. 130.

Habitat.—In the mud of a recess of a mass of *Filograna* from the neighbourhood of the Bell Rock, St. Andrews Bay, 1863.

The *cephalic region* seems to agree with that of *M. infundibulum* both in the absence of a collar and in other respects. The branchiæ form a rich green spiral mass in repose (Plate CXVI, fig. 1a), a position often assumed in its sheath under examination, but when it protrudes the anterior end the branchiæ spread out as a double fan (Plate CXVI, fig. 1) of nine or ten filaments, which have a chordoid axis and a terminal process, which differs from the tapering elongated one of *M. infundibulum* in maintaining its strap-like breadth till near the tip, where a short tapered region occurs.

Body capable of considerable elongation, and the total number of segments is about forty-seven—eight anterior and thirty-nine posterior. A well-marked papilla at the anus terminates the body posteriorly. The colour is a rich green, the central intestine being darker.

The first pair of bristle tufts has a different direction from those which follow—being directed obliquely forward and outward. The anterior bristles are the most conspicuous indeed in a specimen so minute the posterior bristles at first escape notice. The typical anterior bristle (Plate CXXX, fig. 6) has a slender translucent shaft, a finely tapered tip and narrow wings. The posterior bristles are more minute and the wings less distinct. Many present a curvature at the commencement of the tip.

¹ “ Dans cette espèce le sang, au lieu d'être rouge comme chez la plupart des Annelides ou à peu près incolore comme chez les Aphrodites, etc., est de couleur verte.”

The anterior hooks are in groups of five or six, and are long *f*-shaped structures which resemble somewhat those of Oligochæts. The wide region or shoulder is in front of the middle (Plate CXXX, fig. 6*a*), the shaft tapering downward to the base, and upward to the long neck, which is almost straight. The main fang leaves the neck nearly at a right angle, is short and sharp, and on the crown above is a single prominent tooth. The whole organ thus characteristically differs from that of *M. infundibulum*. The posterior hooks (Plate CXXX, fig. 6*b*) are minute, have a long, sharp main fang, and another above it almost as long, a nearly straight posterior outline, and a short base directed forward. The annelid secretes a transparent gelatinous tube in captivity and clings tenaciously to it.

At least three species of *Myxicola* thus inhabit British waters, but in regard to the green example, it may be a question whether it is not a marked variety, with more transparent branchiæ of the type with the minute bifid anterior hooks. Fresh investigations are necessary. Only a single specimen has hitherto been obtained.

Milne Edwards' figure was copied by Chenu (1843-53). This figure is pale greenish throughout with seven dark spots along each branchial filament. In the dissection the nephridia hang out as long processes anteriorly. No distinct collar is shown, but apparently several folds occur in the region. Except for the collar-region it resembles a Sabellid of the ordinary type, with seven tufts of thoracic bristles.

Milne Edwards¹ gave a drawing in which, besides the branchiæ, two pale tentacles on the inner side of the fan were shown.

FAMILY XXXI.—SERPULIDÆ, *Burmeister, Grube.*

Tubicola, Cuvier and Schweigger; *Chetopodes tubicoles*, Cuvier, 'Règne Anim.,' 1830; *Anapulata cephalobranchia* seu. *tubicola*, M. Edwards; Capitibranchiata (sub-o.), (Ersted, 1844, Siebold and Grube; Cephalobranchiata (*nom. emend. quorund.*)).

Cephalic lobe fused with the buccal segment, generally fascicles of bristles in the collar, which is open dorsally and fuses behind with the thoracic jacket; mouth between two semi-circular, circular or spirally contorted laminae; cephalic region furnished with pinnate branchiæ, one or more (dorsal) of which terminates in an operculum or is specially modified into that structure. Branchial vessels simple. Body vermiform, of two regions; segments short; anterior segments fewer and thicker, ranging from three to nine, usually seven, and bearing fascicles of bristles dorsally, rows of hooks ventrally, the reverse arrangement occurring posteriorly; collar fused with a thoracic cloak or jacket, which is open dorsally, the arrangement of which distinguishes the family from the Sabellids, and by some considered to be fused cirri; no copragogue; dorsal and ventral surfaces ciliated at intervals; two glands anteriorly, with a common excretory duct; glandular shields only in anterior region. Bristles various—massive with two short cones and a terminal whip, geniculate, with or without a gap at the tip, brush-like, capillary and bayonet-like. Hooks very thin, thus diverging from those of the Sabellids. Tube calcareous, more or less fixed to solid substances; gregarious. Cosmopolitan.

In the 12th Edit. of the 'Systema Natura of Linnæus,' annotated by his son, the description of *Serpula* is "animal Terebella. Testa univalvis, tubulosa adhærens (sæpe isthmus

¹ 'Règne Anim.,' pl. 1*a*, fig. 2.

integris intercepta"), the clause in brackets referring to the shell of *Vermetus*, a mollusk, for the tube of a Serpulid differs—in having no septa. The Serpulidæ, as understood by him, included forms which the labours of Pallas, Poli, Cuvier, Lamarek and De Blainville showed were widely divergent, *e.g.*, *Vermetus*. They were placed under his "Vermes Testacea"; the animal, he thought, was allied to *Teredo*.

The Serpulidæ of Savigny (1820) included a heterogenous series, viz., Terebellids, Hermellids, Serpulids, Amphictenids, Sabellids, Maldanids and Arenicolids, and hence his description is of little service in a modern classification. On the other hand, his account of the characters of the Serpulids proper is fairly good, and he made three groups according to the form of the branchiæ, viz., *Serpulæ simplices*, *S. cymospiræ*, and *S. spiramellæ*.

Dr. Fleming¹ (1825), in his account of the British Testaceous Annelids, included the Mollusk *Dentalium* as one of the genera of the group, and he refers throughout to both living and extinct forms. His genera of Serpulids were *Vermilia*, *Serpula* and *Spirorbis*. He included under *Vermilia* the living forms *V. intricata*, L., *V. vermicularis*, Ellis, *V. triquetra*, Sowerb., *V. serrulata*, Flem., *V. armata*, O.F.M., and *V. conica*, Mont.; under *Serpula*—*S. tubularia*, Mont., and *S. cordineri* (?) Flem., the latter probably a foreign species. Under *Spirorbis* he placed *S. granulatus*, L., *S. carinatus*, Mont., *S. communis*, L., *S. spirillum*, L., *S. corrugatus*, Mont., *S. Montagui*, Flem., *S. incurvatus*, Walker, *S. pervius*, Walk., and *S. retorta*, Walk. It is difficult in some cases to ascertain the precise species referred to, since the shell varies considerably, though in others the diagnosis is reliable.

Risso² (1826) characterised the Serpulids as having a solid calcareous tube with a single aperture, separate branchiæ protected by an operculum. His account of the genus *Serpula* included a fairly accurate general description of the annelid.

Delle Chiaje³ (1828) figures a *Sabella eupleana* with two opercula, which from the description would appear to be a Serpulid, though the tube is dark coloured and mottled as if from secretion and foreign fragments.

The Serpulidæ were arranged by Cuvier under his Tubicolæ, a group of his articulated animals.

Under the Serpulidæ Grube (1851), following Savigny, comprised the Sabellidæ and Eriographididæ, and he grouped the Serpulids proper according to the condition of the branchiæ (*e.g.*, spirally rolled) or the structure of the operculum.

Kölliker⁴ (1864) describes and figures the palpocils (Tasthaare) on the branchiæ of a *Serpula*.

De Quatrefages (1865) amalgamated with some reason the Sabellidæ and Eriographididæ with the Serpulids, making one great family—the Serpulidæ. So far as can be observed, however, no advantage is gained by this arrangement, and the various important differences between the respective groups are minimised. Carus, in his 'Fauna Mediterranea' (1885), followed the same arrangement.

Dr. Johnston's (1865) Serpulidæ included the Sabellidæ and Eriographididæ as well as the Serpulids proper.

¹ 'Edin. Philos. Journ.,' vol. xii, 1825, p. 238.

² 'Hist. L'Europe Merid.,' t. 4, p. 401.

³ 'Memorie,' vol. iii, p. 227, Tav. xlviii, fig. 21.

⁴ 'Kurzer Bericht,' p. 17, pl. vi, fig. viii.

Claparède (1868) notes that the Serpulids have no proper ciliated groove ventrally, though that surface is partially ciliated as De Quatrefages first showed. These cilia probably effect the same purpose as the "*sillon coprogogue*" of the Sabellids. The ciliated thoracic membrane is from its great vascularity probably an accessory respiratory organ. The author records fresh examples of hermaphroditism in *Laonome*, *Salmacina* and *Pileolaria*. He points out that the anterior region in the Serpulids is more or less solid from the filling up of the cœlom in connection with the great development of the branchial apparatus. The circulation resembles that in the Sabellidæ, and a vascular plexus exists round the gut. The blood is dichroic. In the nervous system the greatest development of the tubular fibres occurs, and the cords are far apart. He was of opinion that only a pair of segmental organs were present, and that in those forming a calcareous tube the contents effervesced with acid.

Fritz Müller¹ cites the case of a developing tubicolar worm in the earliest condition of which three pairs of branchial filaments occurred like *Protula*. A few days after one of these filaments became thickened at the extremity into a clavate operculum resembling *Filograna*. In three days more a new pair of branchial filaments had sprouted out, the opercular peduncle had lost its lateral filament and the worm appeared as a *Serpula*.

Schenk² (1874) gave a brief account of the structure of the body-wall in *Serpula uncinata*. In his transverse sections of the body-wall he appears to have overlooked the nerve-trunks, though traces of these occur in his figures. He further describes³ the early development of *Serpula uncinata*, Grube, or *Serpula (Eupomatus) uncinatus*, Philippi, which he found at Trieste. The adults had the cœlom filled with ova or spermatozoa as far forward as the sixth segment. The ova are round and 0·08 to 0·06 mm. in diameter. He describes the changes in the developing egg, the formation of polar globules, the retraction of the yolk, segmentation and nuclei, and the formation of the segmentation-cavity. He does not touch on the later stages.

Huxley's⁴ view (1877) of the anterior region was that—"In some (*Serpulidæ*) a tentacle is enlarged and its end secretes a shelly plate, which serves as an operculum, and shuts down over the mouth of the calcareous tube inhabited by the animal."

Grube (1878) placed the Serpulids along with *Myxicola* and the Sabellids, under his Family Serpulacea. He used the operculum largely in his diagnosis of species. There is certainly much in common in the groups, such as the arrangement of the branchiæ, bristles and hooks in the anterior and posterior regions, though the nature of the tube generally differs.

Haswell⁵ (1889) found a curious Isopod, which he termed *Eisothistos vermiformis*, commensalistic or parasitic, in the tube of one of this family (viz., a *Vermilia*) from low water mark, Watson's Bay, Australia. Later (1884) he made the interesting observation that in *Eupomatus elegans* of Port Jackson the ova were developed in the nephridia of the posterior region.

Häcker (1896) observes that the early larval Serpulid is a monotrochous trochophore.

¹ 'Facts and Arguments for Darwin' (1869), p. 112, figs. 65, 66 and 67.

² 'Sitzb. K. Akad. Wiss. Wien,' Bd. lxx, pp. 1 and 2, pl. i.

³ Ibid., Bd. lxx, pp. 1—15.

⁴ 'Inverteb.,' p. 235.

⁵ 'Proc. Linn. Soc. N.S.W.,' vol. ix, part 3, sep. copy, p. 1, pl. xxxvi.

In *Eupomatus* Meyer figures the opercular stalk toward the base as triangular, with a smaller central area than in *Pomatocerus* and three longer nerves, the muscular band being nearest the point of attachment.

Salensky¹ (1882) describes the development of *Psygmobranchus protensus*, which he found mature in April and May at Naples, the ova being in gelatinous masses near the outer surface of the tube. Development is rapid. The eyes appear before the differentiation of the ganglia. He found two ciliated tubes anteriorly on the ventral surface which he thought akin to the cephalic kidneys described by Hatschek in Annelids and Mollusks. He considered the separate nerve-cords in the Serpulids as secondary, not primitive, and intermediate between the widely separated Nemertean trunks and the fused ganglionic series. The free-swimming larva becomes surrounded by a delicate membranous tube and by-and-by becomes fixed. The subœsophageal ganglia are not separated from the cephalic except by a constriction. The young annelid has a distinct head separated by a neck. A primitive blood-cavity which contracts rhythmically is formed after fixation, and he thought the blood-vascular system, which is formed later, is at first in intimate connection with this.

Levinsen (1883) made his group *Sabelliformia* include the Sabellidæ and Serpulidæ. He arranges the Serpulids thus:—*Filigrana*, *Apomatus*, *Pomatocerus*, *Hydroïdes*, *Placostegus*, *Ditrupa*, *Spirorbis*, *Chitinopoma*, *Hyalopomatus*, and *Protula*. He also grouped them according to the form of the tubes as follows:—*Ditrupa*, *Filigrana*, *Spirorbis*, *Placostegus*, *Pomatocerus*, *Chitinopoma*, *Serpula*, *Hydroïdes*, *Hyalopomatus*, *Apomatus*, and *Protula*.

Pruvot² (1885) found in *Serpula philippi*, Mörch, four cephalic ganglia, as in the Sabellids, and the connection of these with the anterior glands is intimate. The external ganglia give off the stomato-gastric. He holds that the operculum represents the first dorsal branchial cirrus modified. The “antennæ” (tentacles) on the other hand do not represent branchial filaments.

Hatschek³ (1885) carefully examined the development of *Eupomatus uncinatus*, Philippi (*Serpula uncinata*) at Messina, describing the segmenting egg and thereafter up to the trochophore stage with prototroch, sensory plate, eyes, statocysts, mouth, alimentary canal, vent, muscular bands, anal vesicle and head-kidney. He combats Stossich's view that the Gastrula-mouth becomes the anus, since both he and Von Drasche found that the blastopore became the mouth.

In *Serpula* Cunningham (1888) observes that the neural canals are similar to those of Sabellids.

De St. Joseph (1894) placed much weight on the structure of the hooks of the Serpulids in their classification, and he mentions five different forms.

1. Hooks with few teeth, and terminating anteriorly in a large tooth pointed like the rest:—Gen. *Serpula*, *Hydroïdes* (*Eupomatus*, Phil., *Eucarphus*, Mörch, *Polyphragma*, Quatref.), *Crucigera*, Benedict, *Protis*, Ehlers.

2. Hooks with numerous fine teeth and terminating anteriorly in a longer and more obtuse tooth than the rest:—Gen. *Filigrana*, Oken, *Salmacina*, Clap., *Filigranula*, Lang, *Spirorbis*, Daud., *Pileolaria*, Claparède, *Omphalopoma*, Mörch, *Vermilia*,

¹ ‘Arch. Biol.’ t. 3, 1882, p. 345, pls. xiv and xv.

² ‘Arch. Zool. Expér.’ 2^e sér., t. iii, p. 320.

³ ‘Arbeiten Zool. Inst. Wien,’ t. vi, p. 1, Taf. i—v.

Lamck., *Galeolaria*, Lamck.?, *Ditrypa*, Berk?, *Hyalopomatus* (var. *Marenzelleri*), *Chitinopoma*, Lev.?

3. Hooks with more or less numerous teeth, more or less fine, terminating anteriorly in a large process convex dorsally, and hollowed ventrally like a gouge:—Gen. *Pomatocerus*, Phil., *Spirobranchus*, Blv., *Pomatostegus*, Schm.

4. Hooks with a free border, thickened, rounded, and not denticulated, having transverse parallel striæ, and terminated by a small enlargement in the form of a gouge¹:—Gen. *Placostegus*, Phil.

5. Hooks with numerous and extremely fine denticulations, deeply hollowed anteriorly, and terminating at the other end by a curved spine (not grooved), sharper and longer than in the preceding type:—Gen. *Protula*, Risso (incl. *Psygmodbranchus*, Phil.), *Apomatus*, Phil.

The hooks keep to the same type anteriorly and posteriorly, though the latter may be smaller. It is otherwise with the bristles, which differ in the two regions of the body, and especially do those of the first segment differ.

The peculiar bristles of the first segment only exist in fifteen genera; in the others (*Vermilia*, *Galeolaria*, *Ditrypa*, *Hyalopomatus*, *Pomatocerus*, *Protula*, *Apomatus*) they do not differ from the other bristles of the anterior region. In the genus *Placostegus* only the first segment is devoid of bristles, which are replaced by a band of eyes. On account of this exception and because the bristles of the first segment vary in the same genus, Langerhans attributes only secondary importance to this condition, but the variations are also very great between the thoracic and the abdominal bristles.

The peculiar bristles of the first segment fall under five types:—

1. Massive bristles with a long terminal whip, preceded by two short cones:—Gen. *Serpula*, *Hydroides*, *Crucigera*.

2. “Kneed” bristles in which the terminal blade is preceded by a “bite,” with a serrated edge:—Gen. *Filograna*, *Salmacina*, *Filogranula*, *Spirorbis*, *Pileolaria*, *Protis*, *Chitinopoma*, and *Omphalopoma*.

3. “Kneed” bristles without the “bite,” and without its serrated edge:—Gen. *Spirorbis*, *Omphalopoma*.

4. Bristles indented in front of the terminal point, which is brush-like.² Gen. *Spirobranchus*, *Pomatostegus*.

5. Simple acicular bristles:—Gen. *Omphalopoma*.

The thoracic bristles (other than those of the first segment) can be ranged under three types:

1. Capillary bristles more or less winged:—Gen. *Serpula*, *Hydroides*, *Crucigera*, *Vermilia*, *Galeolaria*, *Spirorbis*, *Pileolaria*, *Pomatocerus*, *Spirobranchus*, *Pomatostegus*, *Ditrypa*, *Hyalopomatus*, *Protula*, *Protis*.

2. Bristles in which the curved extremity is preceded by a wing in most of the thoracic segments:—Gen. *Spirorbis*, *Vermilia*, *Omphalopoma*, *Apomatus*.

3. Bristles with a curved, serrated extremity without the wing preceding it:—Gen. *Filograna*, *Salmacina*, *Filogranula*, *Spirorbis*, *Chitinopoma*.

The last segments of the abdomen generally bear simple capillary bristles in connection

¹ Marenzeller, ‘Denks. K. Akad. der Wiss. Wien,’ Bd. lx, p. 93, pl. iv, fig. 17 b.

² Ehlers, ‘Annel. Blake,’ vol. xv, 1887, pl. lvii, fig. 11, and pl. lviii, fig. 1.

with the functions of the part. The other bristles of the abdomen range themselves under six types:

1. Absolutely capillary:—Gen. *Ditrupa*, *Hyalopomatus*, *Protis*.
2. Bayonet-like bristles with a striated margin simulating denticles:—Gen. *Protula*.
3. Bristles with sickle-like curved tips:—Gen. *Spirorbis*, *Protula*, *Apomatus*.
4. Bristles more or less "kneed" (geniculate) and more or less denticulate on the edge:—Gen. *Filograna*, *Salmacina*, *Filogranula*, *Spirorbis*, *Pileolaria*, *Vermilia*, *Galeolaria*?, *Omphalopoma*, *Chitinopoma*, *Placostegus*, *Apomatus*.
5. Trumpet-like bristles (flattened) with serrated border:—Gen. *Serpula*, *Hydroides*, *Crucigera*.
6. Trumpet-like bristles (flattened) with serrated border, which is prolonged into a tapered point:—Gen. *Pomatocerus*, *Placostegus*, *Spirobranchus*, *Pomatostegus*.

It is clear that the various forms of bristles occur in allied genera and that other features require consideration, whilst the hooks remain fairly characteristic of genera. De St. Joseph therefore combines in his classification secondary characters with these, such as the form of the operculum, the presence or absence of a thoracic membrane, the branchiæ, tube (right or left spire) more or less coiled. His classification is:—

A. Hooks with numerous teeth terminating anteriorly in a large tooth pointed like the others.

I. Bristles of the first thoracic segment massive, with a long terminal region preceded by two short spikes or cones. Rest of the thoracic bristles winged. Abdominal bristles compressed, trumpet-shaped, serrated distally, an operculum:—*Serpula*. Operculum funnel-like, denticulate on the edge:—S.G. *Serpula*, s. str., Phil. Funnel-like operculum, the centre of which is elevated by spines and bayonet-like paleæ:—S.G. *Hydroides*, Gunn. (*Eupomatus*, Phil., *Eucarphus*, Mörch, *Polyphragma*, De Quatref.), *Crucigera*, no operculum, Benedict, *Protis*, Ehlers.

II. Hooks with finer and more numerous teeth than the preceding—terminating anteriorly in a long tooth larger and more obtuse than the others:—Ex. *Chitinopoma*, Levinsen, *Filograna*, Oken, *Salmacina*, Clap., *Filogranula*, Langerhans, *Spirorbis*, Daudin, *Pileolaria*, Clap., *Janna*, De St. Joseph, *Omphalopoma*, Mörch, *Circeis*, De St. Joseph, *Omphalopomopsis*, De St. Joseph, *Janita*, De St. Joseph, *Leodora*, De St. Joseph, *Mera*, De St. Joseph, *Hyalopomatopsis*, De St. Joseph, *Vermilia*, Lamarek, *Galeolaria*, Lam., *Vermiliopsis*, De St. Joseph, *Ditrupa*, Berkley, *Dasynema*, De St. Joseph.

III. Hooks with more or less numerous teeth, more or less fine, terminating anteriorly in a large spine, smooth dorsally, grooved like a gouge ventrally:—Ex. *Pomatocerus*, Phil., *Spirobranchus*, Blv., *Pomatostegus*, Schmarda, *Placostegus*, s. str., *Placostegopsis*, De St. Joseph.

IV. Hooks with numerous and extremely fine denticulations deeply hollowed anteriorly, and terminating at the other extremity by a smooth spine (not hollowed), more slender and longer than in the type III:—*Protula*, Risso (including *Psygmobanchus*, Phil.), *Protula*, s. str. (*Protula tubularia*, Mont.), *Protulopsis* (*Protula intestinum*, Mont.), *Apomatus*, Phil., Mörch, and *Apomatus*, s. str. (*A. globifer*, Théel), and *Apomatopsis*, De St. Joseph (*A. ampulliformis*, Phil., *P. Marionii*, Marenzeller, and *A. Enosinæ*, Marenzeller).

There is much that is of importance in De St. Joseph's classification, and, though it has not been followed, his experienced remarks are in general both trustworthy and interesting.

MacMunn thought that the blood of *Serpula contortuplicata* (*Hydroides norvegica*) presented some resemblance to that of *Sabella*, yet did not contain the same kind of chlorocruorin, but a pigment closely related to it, probably nearer hæmatin.

Gravier (1902) quotes from Zeleny¹ an instance of regeneration of an operculum in *Hydroides diäanthus*—after its removal by the experimenter. The curious feature about this case is that the operculum was not reproduced on its original site, but the rudimentary organ of the other branchial edge developed into a complete operculum.

Soulier² (1878–1902), in memoirs dealing with the development of *Serpula infundibulum*, *Hydroides pectinata* and *Protula Meilhaci*, came to the conclusion that the blastopore formed both the mouth and the anus, the region of the elongated blastopore between them corresponding to the ventral surface of the annelid. Later³ (1906) the same author gave an elaborate account of the fecundation of *Serpula*.

Schepotieff⁴ (1903) gives an account of the minute structure and development of the bristle-bundles of *Protula tubularia* (*P. intestinum*, Philippi), the basal regions of which lie in the cœlom. He describes the bristles as developing from special nucleated cells, and not from a sac, and in the same way the hooks spring from cells at the bottom of an insinking of the epiderm. The so-called bristle-sacs thus do not exist. The same author⁵ furnishes an elaborate account of the structure of Polychæt bristles, referring especially to *Nereis*, *Aphrodita* and *Spirographis*—showing likewise their origin from cells.

Wollebæk (1912) arranges the northern Serpulidæ according to the structure of the branchiæ, the nature of the operculum, the number of the anterior (thoracic) segments, and the nuchal bristles.

Seven species of the family, viz., *Spirorbis borealis*, *S. Fabricii*, Mörch, *S. lucidus*, Mont., *Ditrypa libera*, *Placostegus tridentatus*, *Protula borealis* and *Filograna implexa* were found by M. Sars⁶ at 300 fathoms. Recent investigations have greatly increased the range in depth in these and other cases.

The earlier investigators of the Serpulids gave a large share of their attention to the calcareous tubes, founding species on the nature of the coils and their texture, or, it may be, on the structure of the opercula and branchiæ. No modern investigator, however, would feel safe in relying on these distinctions without also subjecting the bristles, hooks, body-wall and life-history to careful examination. In order to indicate the proportional abundance of the Serpulids in British waters, notes of a few of the collections made by exploring ships and by zoologists at various limited localities are added, as well as extracts from one or two memoirs devoted to the group.

Philippi⁷ (1844) furnished a description of the Mediterranean Serpulids, entering no less than twenty-six, though Grube in the same region had only twelve. Philippi relied much

¹ 'Archiv für Entwickl.,' Bd. xiii, 1902.

² 'Compt. Rend. Acad. Sc. Paris,' t. cxxvi; idem, t. cxxviii; and 'Travaux l'Institut. Zool. Université Montpellier,' Mem. No. 9, 1902, pp. 60, etc., pls. i—iv.

³ 'Arch. Zool. Expér.,' 4^e sér, v, p. 403, pl. x.

⁴ 'Zeitschr. f. wiss. Zool.,' Bd. lxxvii, p. 586, Taf. xxvi—xxviii, 1904.

⁵ Ibid., Bd. lxxiv, pp. 1—57, Taf. xxxiii—xxxvi, 1903.

⁶ 'Vidensk.-Selsk. Forhandl.,' 1868, pp. 9 and 10 (sep. copy).

⁷ 'Arch. f. Naturges.,' Bd. x, p. 186, Taf. vi, figs. A—T.

on the structure of the opercula, and, in the case of *Protula*, on the spiral arrangement of the branchiæ, or the fan-like nature of the branchiæ in *Psygmobranchus*. These data were insufficient, and consequently considerable confusion resulted. Thus, for instance, his genus *Vermilia* included six new species, and of the two known forms, one was the common *Pomatocerus triqueter*, and the other was probably synonymous with the ubiquitous *Serpula vermicularis*, entered, as also was the former, under another genus.

Mörch¹ (1861-63), in his 'Revisio Critica Serpulidarum,' has about 135 species of Serpulids under 16 genera, *Spirorbis* having no less than 27, *Hydroides* 17, *Serpula* 14, *Vermilia* 12, *Protula* and *Placostegus* each 11, *Ditrypa* 8, and the others smaller numbers. This list could be considerably reduced almost under every genus.

Dr. Johnston² (1865) enters 10 species of Serpulæ in the body of the work, and in the Appendix Dr. Baird added another and no less than 17 species of *Spirorbis* from the literature on the subject, but in both cases the number needs substantial reduction, since some appear under two or three titles.

De Quatrefages³ (1865) mentions about 109 species as occurring throughout the ocean, but it is evident that many are synonymous, and that the series could be much reduced.

Twenty species are recorded by Malmgren⁴ from the extensive northern waters, ranging from Greenland to the North Sea, but some of these are evidently doubtful, such as the second species of *Filograna* and several species of *Spirorbis*, and there is also doubt concerning *Vermilia* and the two species of *Ditrypa* and *Hydroides*.

Claparède⁵ (1868) includes 10 Serpulids in his Neapolitan Polychæts, and they are spread over 9 genera, of which *Psygmobranchus* alone has two species.

Grube⁶ (1877), records only two species in the extensive collections of the German ship "Gazelle," viz., a *Serpula* and a *Pomatocerus*. In his Philippine Annelids 7 Serpulids are entered, six falling under *Serpula* and one under *Ditrypa*.

Levinson⁷ (1883) includes 20 species in his northern Polychæts, 7 being *Spirorbids*, the rest distributed over 9 genera, of which *Protula* and *Ditrypa* each have two.

In the great Expedition of the "Challenger," through the diverse waters of the world,⁸ 22 Serpulids were encountered, the genera most in evidence being *Protula* (4), *Serpula* (5), and *Placostegus* (5), the three thus representing more than half the total number secured. It is interesting that not a single complete *Spirorbis* (only two or three fragments of tubes) was obtained. In all probability the haunt of the majority of the *Spirorbids* is the littoral region both of foreign seas and our own.

The Expedition of the U.S. Coast Survey Steamer "Blake,"⁹ in the rich waters of the Gulf of Mexico and the Caribbean Sea, produced under the able hands of Ehlers (1887) only

¹ 'Naturhist. Tids. Kjøbenhavn,' Bd. i, p. 347.

² 'Cat. Worms Brit. Mus.,' pp. 264 and 346.

³ 'Annel.,' t. ii, p. 484, etc.

⁴ 'Annul. Polych.' (sep. copy), p. 119.

⁵ 'Annél. Chétop. Naples.'

⁶ 'Monat. Königl. Akad. Wiss. Berlin.'

⁷ 'Meddel. nat. Forh. Copenhagen,' p. 189, etc.

⁸ '"Challenger" Reports,' vol. xii.

⁹ "Results of Dredging, etc.," 'Mem. Museum Comp. Zool. Cambridge, U.S.A.,' vol. xxxi.

11 species, but spread over 9 genera, *Spirobranchus* having three species, each of the others having but one representative.

Twenty-six species of *Spirorbis* are described by Caullery and Mesnil¹ (1897) in their important memoir on the genus, and collected from various parts of the world.

Ehlers² (1901) has 13 Serpulids in the collection of Polychæts from the Strait of Magellan and from Chili, of which 8 are Spirorbids, the rest spread over 4 genera.

In the careful account of the Serpulids from the Pacific Coast of N. America by Mrs. Pixell Goodrich³ (1912) 18 species are recorded, more than half of which are Spirorbids. The same authoress (1913) describes 6 in her report on the Serpulids of the Scottish Antarctic Expedition, 3 being Spirorbids, and 3 other genera having one each. She (1913) enters no less than 25 species secured by Prof. Stanley Gardiner in the "Percy Sladen Expedition" to the prolific waters of the Indian Ocean. About half of these are under 2 genera, viz., *Hydroides* (5) and *Spirobranchus* (8), two of the other genera having 2 species and *Spirorbis* 3.

Twenty-nine species appear from the wide area included in the Campagnes Scientifiques of the Prince of Monaco, and by the experienced hands of Prof. Fauvel⁴ (1914); 7 of these are Spirorbids.

In Canon Norman's Norwegian dredgings 3 species were obtained, viz., *Hydroides norvegica*, *Serpula vermicularis*, and *Ditrypa arietina*. The same forms with the addition of *Placostegus tridentatus* at 305 fathoms were procured by the "Knight Errant." In the "Porcupine" Expedition of 1869 *Protula protense*, *Filograna implexa*, *Hydroides norvegica* and *Ditrypa arietina* were dredged. The list was slightly extended in the "Porcupine" Expedition of 1870, for, in addition to those mentioned above, a variety of *Placostegus*,⁵ if not a new species, was obtained off Cape De Gatte in 45 fathoms, and *Pomatocerus triqueter* from Ras el Amush. The great numbers of *Ditrypa* from Bono Bay and their comparatively small size were noteworthy.

The paucity of Serpulids in local faunas is remarkable. Thus in the 'Catalogue of the Marine Invertebrates and Fishes of St. Andrews' (1875) 7 occur, two being Spirorbids, the others distributed over various genera. The same number is given by Marion and Bobretzky⁶ (1875) at Marseilles, two belonging to the genus *Apomatus*, the others singly to different genera. Leslie and Herdman⁷ (1881), in their 'Invertebrate Fauna of the Firth of Forth,' enumerate 3 Serpulids, two of which are Spirorbids. Langerhans⁸ (1880) enters 11 from Madeira, three of which are Spirorbids. Some of the entries are doubtful. Harvey Gibson⁹ (1886) mentions 7 in his 'Catalogue of the Vermes of the Liverpool District,' but one of the two Spirorbids is uncertain. Nineteen species are entered by Lo Bianco¹⁰

¹ 'Bull. Sc. France et Belgique,' t. xxx, p. 185, pls. vii—x.

² 'Polychæten Magell. u. Chilen. Strändes.'

³ 'Proc. Zool. Soc.,' 1912, p. 784.

⁴ Fascicule xlvi.

⁵ *Vide* subsequent account.

⁶ 'Ann. Sc. nat.,' 6^e sér., t. iii, p. 94.

⁷ 'Proc. Roy. Phys. Soc. Edin.,' vol. vi, p. 67.

⁸ 'Zeitschr. f. wiss. Zool.,' Bd. xxxiv, p. 118.

⁹ 'Proc. Lit. Phil. Soc. L'pool,' vol. xl, p. 159.

¹⁰ 'Atti Acad. Sc. Fisiche Mat. Napoli,' vol. v, No. 11, pp. 81—93.

(1893) in his 'Tubicolous Annelids of Naples,' and several of these are synonymous. As a result of many years of patient labour at Dinard, France, De St. Joseph met with 9 species, all under diverse genera. A single species of *Spirorbis* is included.

Southern¹ (1914) enters 8 species in the Survey of Clare Island, three of which are Spirorbids.

Six occur in Allen's² 'Catalogue (1915) of the Polychæta of Plymouth and South Devon,' three of which are Spirorbids.

An interesting paper is that of P. P. Ivanoff³ on regeneration and ontogeny. He shows that in the regeneration, for instance, of both anterior and posterior ends of *Spirographis* the mesoderm is formed by the immigration of cells from the ectoderm. In the development of *Eupomatus* he holds that the primary mesoblasts are used up in the formation of the three primary somites of the larva, whilst the mesoderm of the posterior segments is derived from the cells of the ectoderm. Taking a broad view of the subject in the Spionids, Chaetopterids, Sabellids and Serpulids, he is of opinion that regeneration of the anterior end in these two latter differs from normal development, for, whilst the three anterior segments correspond to the three post-oral segments of the larva, these truly regenerate the cephalic lobe and the rudimentary segment supporting the branchiæ, and are themselves derived from abdominal segments. Regeneration of the posterior region is aided by the direct passage of the epithelium from the ectoderm, and the new part corresponds to the posterior end of a young form.

He concludes by averring that regeneration and ontogeny are not antagonistic to each other, but are analogous. They are mutually confirmative and explanatory. In the Sabellids and Serpulids the head and three anterior segments are regenerated because these are the primary segments, larval, and distinctly individualised in ontogeny. He does not affirm that regeneration repeats ontogeny strictly, for certain anomalies occur, due to the initial disposition of cellular material. Moreover, this process reflects also the phylogeny as well as the ontogeny of the species.

An elaborate paper on the various formations in the Polychæts is given by N. Livanoff in the forty-sixth volume (No. 2) of the 'Zootomical Institute of Kasan, (1914), chiefly from investigations on the Eunicidæ. As the paper is in Russian its contents are at present imperfectly known.

N. Livanoff⁴ of Kasan (1917) describes certain "cœlothelial fibres" in the minute anatomy of various Polychæts, such as *Amphitrite variabilis*, Risso, as occurring on the walls of the intestine, the nephridia and the dissepiments, and as distinct from muscular fibres. He also points out that the so-called ringed muscles in connection with the bristles of *Onuphis conchylega*, Sars, are neither muscular nor elastic, but only folds of a fine cuticular membrane enveloping the bristle.

In Britain the Serpulids, though beautiful, are less conspicuous than in warmer seas. Thus Mr. Crossland describes them in the Red Sea as among the most gorgeous denizens of

¹ 'Proc. R. Irish Acad.,' vol. xxxi, No. 47, p. 146.

² 'Journ. M. B. A.,' N.S., vol. x, p. 643.

³ 'Russian Journal of Zoology,' vol. i, 1916.

⁴ 'Pyc. Zoar Kyph,' 1917, ii.

coral reefs. In some arborescent corals nearly every branch is hollow and contains a Serpulid over the ordinary tube round which the coral polyps have spread and enclosed it. Yet even in Britain the rocks and stones near low water on both eastern, and especially the western, shores, are covered in many cases with the white tubes of *Pomatocerus*, and many stones and shells from deep water are similarly coated with *Hydroides* or other form. Moreover, the vast number of the Spirorbids on stones, the blades of *Fuci*, and the stems and branches of corallines inshore and off shore still further extend their distribution.

The Serpulids are a very old group, ranging from the Silurian rocks upward, some, such as *Serpula*, occurring in the Upper Silurian, Devonian, and Carboniferous formations, *Spirorbis* again extending from the Upper Silurian to modern times. Recent remarks on some of the genera have been made by F. Chapman¹ and other authors.

An interesting point in the development of the Polychæts is the fate of the vitelline membrane. Not a few authors, such as Barrois, Malaquin, Salensky, Wilson, Drasche, Treadwell, Claparède, Mecznirow and others hold that it becomes the cuticle of the larva. Others, again, such as Vignier for *Grubea*, Götte for *Nereis*, Drasche for *Sabellaria*, Wilson for *Chaetopterus*, and Eisig and Pierrantoni for *Capitella* and *Saccocirrus* state that it disappears. In the present group Claparède and Mecznirow state that it disappears in *Spirorbis*, *Fabricia* and *Dasychone*, Salensky observed it disappear in *Pileolaria*, Götte in *Spirorbis*, Hatschek in *Eupomatus*, Roule in *Dasychone*. Stossich, on the other hand, insists that it forms the cuticle in *Eupomatus*, and Conn in *Serpula uncinata* and *S. glomerata*. A recent research by Soulier² demonstrates that the vitelline membrane in *Serpula crater* and *Protula* gradually disappears during development, splitting at the posterior end and then vanishing in front. The same author³ (Soulier) goes minutely into the fifth stage of segmentation (thirty-two cell-stage) of *Protula meilhaci* after the manner of the American authors, showing the origin of the various blastomeres (micromeres and macromeres), and in a subsequent paper⁴ treating of further stages—cross and rosette. He thinks that the differences between the development of *Protula* and *Nereis* and *Capitella* are only secondary.

Genus CLXXVI.—PROTULA, Risso, 1826.

Protula, Risso, 'L'Europa mérid.' p. 405; *Protula*, Blainville, Milne Edwards and Grube; *Sabella*, Cuvier, 'Règ. Anim.', iii, 1830, p. 192; *Apomatus*, *Psygmobranchus*, Philippi, Wieg, 'Archiv,' 1844, p. 189; 'Ann. Nat. Hist.,' xiv, pp. 155 and 156; *Terebella*, Blainville, 'Dict. Sc.,' t. lvii, p. 435.

Cephalic region truncate, with a free collar, the edge of which is continuous. Branchiæ plumose and fan-shaped, the filaments united in a tough base, occasionally spiral. Tentacles two. Body elongate and tapering posteriorly; the anterior region of eight segments with a lateral membrane on each side equal to the diameter of the body, supported by a greatly developed dorsal process of the foot. Posterior region tapering to a terminal anus.

¹ 'Journ. Roy. Soc. Victoria,' xxxi, p. 15.

² 'Arch. Zool. Expér.,' t. lvi, No. 1, p. 16, text-figs. 1—3, 1916.

³ Ibid., No. 4, p. 100.

⁴ Ibid., t. lvii, No. 1, p. 14 (1918).

Anterior bristles pale golden, long, slender and finely tapered with slightly curved tips and narrow wings. Hooks, which commence on the second or third segment, borne on a narrow fillet toward the posterior and inner base of the bristle-tuft. They have a long and minutely serrated anterior face, ending in a sharp, conical, large fang inferiorly. Posterior bristles (longer) similar to the anterior, but have no evident wings. Shorter forms have flattened translucent tips. The hooks, which occur on lamellæ, agree in structure with those in the anterior region. Tube long, free or fixed, calcareous and white.

Protula of Risso was placed along with *Spiromella*, Blainv., under *Apomatus* by Philippi¹

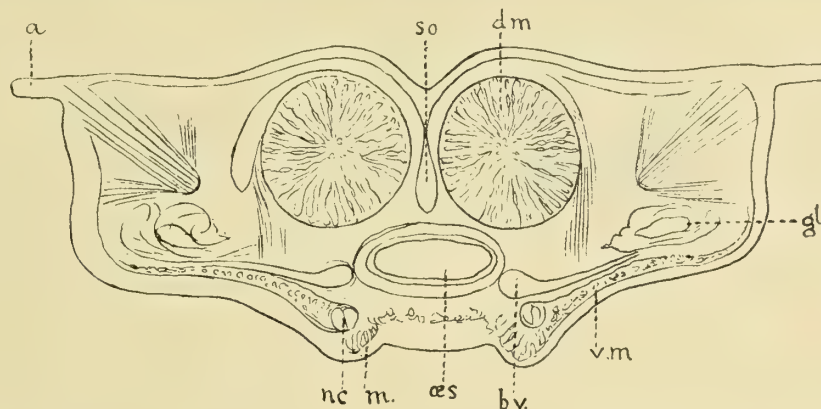


FIG. 165.—Transverse section of *Protula tubularia* in the anterior region. Letters as before.

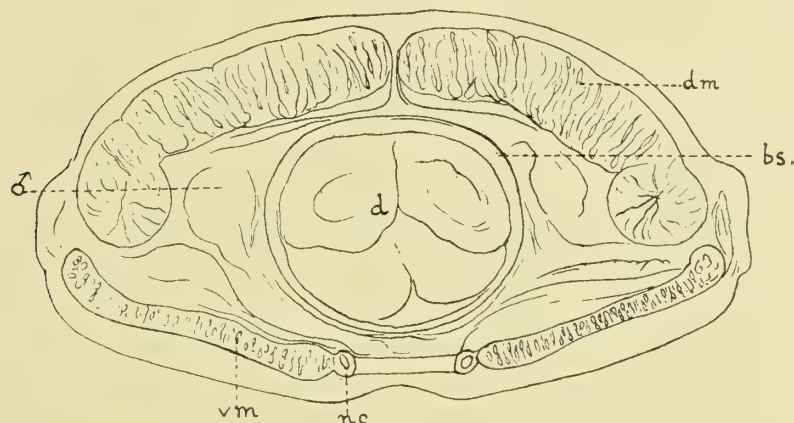


FIG. 166.—Transverse section of the posterior region of *Protula tubularia*. Letters as before.

(1844), that is, in the group without an operculum, though a subsequent remark shows that Scacchi's account of that organ was known to him. He had not seen the animal, but he quoted Cuvier's note on the orange branchiæ.

A feature in the structure of the body-wall in *Protula tubularia* is the great size of the dorsal longitudinal muscles. At the extreme anterior end the dorsal surface has a deep median groove, the rounded parts on each side indicating the projecting dorsal muscles—Fig. 165. The lateral regions, *a*, are formed by extensions of the body-wall, and bear the bristles in each segment. A thin circular coat lies under the hypoderm external to the dorsal longitudinal muscles, and it extends into the lateral regions. Sections of the posterior ends

¹ 'Arch. f. Naturges.,' Bd. x, p. 186, 1844.

of the ganglia or œsophageal connectives lie below the great muscles, and in the mid-ventral line is an elongated area between them. The œsophagus is clasped by strong muscular fibres, the circular coat of the body-wall being external. A projecting process (muscular) occurs on each side of the mid-ventral line. At the outer edge of the space lying below and external to the great dorsal muscle is a muscular band, but such is distinct from the ventral longitudinal muscles, which in section appear as small rounded areas on each side of the middle line, with the nerve-trunks (*nc.*) and the neural canals at their inner borders. The duct (*so.*) of the thoracic glands appears between the dorsal muscles, and further back the glands themselves (*gl.*) are at each side in the sections.

The structure of the body-wall changes in the posterior region (Fig. 166), for the dorsal longitudinal muscles have spread out as thick plates on each side of the middle line, and end in the lateral region in massive areas of folded muscular fasciculi which have a pennate arrangement. A large alimentary canal occupies the centre. The ventral longitudinal muscles are still proportionally small, forming in sections elongated plates somewhat thicker externally, with the nerve-cords and their large neural canals at the inner edge.

1. PROTULA TUBULARIA, *Montagu*, 1803. Plate CXV, fig. 6—tube; Plate CXVI, fig. 2—body; Plate CXXI, fig. 5—branchia; Plate CXXX, figs. 7—7*b*—bristles and hook.

Specific Characters.—The cephalic region has dorsally a fillet trending upward on each side to join the acutely pointed dorsal folds of the collar, which forms a continuous frill on the lateral and ventral edges. Branchiæ in two fans, the filaments in each ranging from thirty to sixty; usually uncoiled in the preparations, though the tips are often curved, and end in free subulate processes of considerable length; pinnæ of moderate length, closely arranged in two rows, which diminish in size, to end in short papillæ at the base of the terminal process. A bilobed fillet lies dorsally between the bases of the fans, and at its ventral edge is a triangular process. The firm base of the branchiæ is pale, whilst the filaments are straw-coloured with a series of red granules on each side at their origin, and about seven red touches on the outside of the filament, the size of these increasing distally, the last being at the base of the terminal process, which it partly tinges. The orange-red touches colour the bases of the pinnæ so that they are reddish and then straw-coloured, the intermediate ones being pale. The terminal processes are subulate. The tips of the anterior (thoracic) feet are also of the same brick-red, the first being paler than the succeeding. A dark brownish line occurs along the middle of the back.

Body broad anteriorly, tapered posteriorly; length, 2—2½ inches, 70—105 segments. Flattened both dorsally and ventrally, a median groove occurring in the dorsum anteriorly, and on the ventral surface posteriorly. The broad membranous web anteriorly is continuous with the dorsal fold of the collar; it passes laterally above the bristle-tufts—ending ventrally by fusing with the web of the opposite side behind the last bristle-tuft of the anterior region. It is supported by a greatly developed dorsal process of the foot. Anterior region of eight segments, seven of which bear bristles, the first and the last having glandular ventral scutes. Bristles pale golden, long, slender and finely tapered, with slightly curved tips, and very narrow wings. Rows of hooks borne on a ventral fillet toward the posterior and inner base of the bristle-tufts. Hooks translucent, with a long

and minutely serrated anterior face ending in a sharp, slightly curved main fang inferiorly. Tori uncinigeri commence on the third segment.¹ Posterior region of many segments, ending in a terminal anus. A close series of lamellæ along the dorso-lateral region bear the hooks, which agree in structure with those in front. The bristle-tufts are easily removed, and consist of long, slender tapering bristles without evident wings, and of a shorter series with flattened translucent tips. Tube long, free or fixed, calcareous, white, with a longitudinal crest at first, then smooth. Its length ranges from 5 to 6 inches.

SYNONYMS.

1606. *Penicillus marinus Rondeletii*, Aldrovandus. De Test. Lib., iii, p. 561.
 1650. „ = *Meerbensel*, Jonston. Hist. nat. de Exang. Aquat., iv, tab. xvii, cum fig.
 1739. „*Serpulid*,” Rumphius. Thes., pl. xli, No. 3.
 1776. *Protula tubularia*, Martini. N. Syst. Conch., t. i, fig. 124.
 1788. *Serpula protensa*, Gmelin. Linn. Syst. Nat., ed. xiii, vol. i, pt. vi, p. 3744.
 1803. „ *tubularia*, Mont. Test. Brit., p. 513; Suppl., p. 171.
 1806. „ *protensa*. Turton's Linn., p. 604.
 1807. „ *tubularia*, Maton and Rackett. Linn. Trans., viii, p. 244.
 „ „ „ Turton. Brit. Fauna, vol. ii, p. 202.
 1808. *Amphitrite tubularia*, Montagu. MS. vol. Linn. Soc., pl. vii, figs. 2 and 3.
 1810. *Pinceau de mer*, Risso. Hist. des Poiss., ii, p. 76.
 1811. *Serpula tubularia*, Laskey. Werner Mem. I, p. 413.
 1812. „ „ Pennant. Brit. Zool., iv, p. 362.
 1817. *Protula* „ and *P. protensa*, Dillwyn. Recent Shells, p. 1083.
 1818. *Serpula intestinum*, Lamarek. An. s. Vert., v, p. 363.
 1819. „ *arundo*, Turton. Conch. Dict., p. 155.
 1825. „ *tubularia*, Fleming. Edin. Philos. Journ., xii, p. 243.
 1826. *Protula Rudolphi*, Risso. Hist. nat. l'Europe, t. iv, p. 406.
 1827. *Serpula tubularia*, Brown. Illust. Conch., pl. ii, figs. 9 and 10.
 „ *Terebelle dans une tube de Serpula*, Blainville. Dict. Sc., t. lvii, p. 433.
 1828. *Serpula arundo*, Berkeley. Zool. Journ., iii, p. 229.
 1830. „ *tubularia*, Fleming. Edin. Encycl., vii, p. 67, pl. cciv, fig. 9.
 „ „ *protensa*, Bosc. Vers., vol. i (2nd edit.), p. 209.
 „ *Sabella protula*, Cuvier. Règ. Anim., p. 192.
 1834. *Serpula tubularia*, Johnston. Loud. Mag. Nat. Hist., vii, p. 126, fig. 23.
 „ „ „ Berkeley. Ibid., vii, p. 421.
 1835. „ „ idem. Zool. Journ., v, p. 426.
 „ „ „ Johnston. Ann. Nat. Hist., xvi, p. 449.
 1844. *Protula intestinum* and *Psygmobranchus protensus*, Philippi. Arch. f. Naturges., Bd. xix, p. 196.
 1847. *Serpula tubularia*, Landsborough. Excurs. Arran, p. 32.
 1851. *Protula protensa*, Grube. Fam. Annel., pp. 90 and 141.
 „ „ *intestinum*, idem. Ibid., pp. 89 and 141.
 1861. „ *Rudolphi*, Mörch. Rev. Serp., p. 9 (Nat. Tidsskr., p. 355).
 „ „ *intestinum*, idem. Ibid., p. 10 (Nat. Tidsskr., p. 356).
 „ „ *græca*, idem. Ibid., p. 11 (p. 357).
 „ „ (*Psygmobranchus tubularia*, idem. Ibid., p. 13.

¹ *Protula protensa* is said by Carus to have no tori anteriorly.

1861. *Protula protensa*, Grube. Ausflug Triest. u. Quarnero, p. 63.
 1863. *Psymbranchus protensus*, Mörch. Naturh. Tidssk., 3^e sér., t. i, liv. iii, p. 359.
 1864. *Protula protensa*, Grube. Insel. Lussin, p. 92.
 „ „ *borealis*, Sars. Forh. Vid.-selsk. Christ., p. 57.
 1865. „ *protensa*, Johnston. Cat. Worms Brit. Mus., pp. 264 and 346, text-fig. xlv.
 „ „ *Rudolphi*, De Quatrefages. Annel., t. ii, p. 469.
 „ *Psymbranchus protensus*, idem. Ibid., p. 471.
 „ *Protula tubularis*, idem. Ibid., p. 472.
 „ ? *Psymbranchus simplex*, idem. Ibid., p. 472, pl. xv, fig. 13.
 1867. *Protula tubularia*, Parfitt. Cat. Annel. Devon, p. 35.
 1868. *Psymbranchus protensus*, Claparède. Annél. Nap., p. 432, pl. xxx, fig. 7.
 1871. *Protula borealis*, G. O. Sars. Forh. Vidensk.-selsk. Christ., p. 417.
 1874. „ *tubularia*, McIntosh. Ann. Nat. Hist., ser. 4, vol. xiv, p. 206.
 1875. „ „ idem. Invert. and Fishes St. Andrews, p. 131.
 „ „ *intestinum*, Panceri. Atti Soc. Ital., vol. xviii, p. 534.
 „ *Psymbranchus intermedius*, Marion. Revue des Sc. nat., t. iv, p. 470.
 1879. „ „ idem. Ann. Sc. nat., 6^e sér., t. viii, p. 28, pl. xvii, figs. 7—7 c.
 1882. *P. arctica*, Hansen. Norske Nord.-Exped., p. 43, Tab. vii, figs. 28—33.
 „ *Psymbranchus protensus*, Salensky. Archives Biol., t. iii, p. 347, pls. xiv and xv.
 1884. „ „ Langerhans. Zeitschr. f. wiss. Zool., Bd. xl, p. 276.
 1885. *Protula tubularia*, Carus. Fauna Medit., i, p. 278.
 1886. „ *protensa*, Harvey Gibson. Proc. Lit. and Philos. Soc. Liverp., vol. xl, p. 160.
 1887. *Psymbranchus protensus*, Meyer. Mitth. Zool. Stat. Neap., vii, p. 713; viii, pp. 463, 477, 480, 486, 491, 492, 495, 500, 514, 522, 529, 531, 536, 543, 554, 566, 575.
 1889. *Protula protensa*, Grieg. Bergens Mus. Aarb., p. 8.
 1893. „ *tubularia*, Lo Bianco. Atti R. Accad. Sc. Nap. (2), v, p. 89.
 „ „ Von Marenzeller. Polych. Grundes, p. 14, pl. iii, fig. 9.
 1894. „ „ De St. Joseph. Ann. Sc. nat., 7^e sér., xvii, p. 362, pl. xiii, figs. 408—413.
 1896. „ *protula*, Orlandi. Atti Soc. Ligust. Sc. Nat., vol. vii, p. 158.
 1897. „ *protensa*, Michaelsen. Polych. deutsch. Meere., p. 184.
 1904. „ *tubularia*, Journ. M. B. A., vol. vii, p. 232.
 1908. „ „ Ehlers. Deutsch. Tiefsee Exped., p. 160.
 1909. „ „ Fauvel. Bull. Inst. Oceanogr., cxlii, p. 70 (and *Protula intestinum* on p. 71, ibid.).
 „ „ „ Lo Bianco. Mitt. Zool. St. Neap., Bd. xix, p. 586.
 „ „ „ Fauvel. Ann. Sc. nat., 9^e sér., t. x, p. 210.
 1910. „ „ idem. Compt. Rend. Assoc. Française Sc. (1909), p. 693, with text-figs.
 1912. „ „ Crawshay. Journ. M. B. A., vol. ix, p. 347.
 1914. „ „ Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 147.
 „ „ „ Fauvel. Campag. Scient. Monaco, Fasc. xlvi, p. 354.
 1915. „ „ Allen. Journ. M. B. A., vol. x, p. 645.
 1917. „ „ Rioja. Anél. Poliq. Cantáb., p. 90.

Habitat.—Devonshire (Montagu); Berwick Bay (Johnston); Torbay (Griffiths); Loch Torridon (McAndrew); Polperro (Laughrin); Falmouth (W. P. Cocks); Cumbrae (D. Robertson). In the deeper water off St. Andrews Bay (E. M.); Shetland, 1855 (Dr. Howden); The Minch, 1866, St. Magnus Bay, Shetland, in 80 fathoms, 1867, in 110 fathoms 30 miles west of the Blasquet, S.W. Ireland, in 90 to 125 fathoms; 30—50 miles

west of Valentia, Ireland, on a sandy bottom (J. G. J.). A small variety occurs under stones between tide-marks at Herm, and was also dredged on shells off St. Peter Port, Guernsey (W. C. M.); Oban (J. G. J.); Connemara (A. G. Moore). Berehaven, Roy. Irish Acad. Exped., 1885 (small); Plymouth (Spence Bate and B. Rowe, Allen, Crawshay). West Coast of Ireland (Southern): the finest examples come from this region.

Abroad it has been found at Cape Bojeadar (Ehlers); shores of Cantabria (Rioja); 300 fathoms off Norway (Sars); Mediterranean (Grube, Philippi, Panceri, Claparède, Marion); Atlantic; Adriatic (Marenzeller); shores of France (De Quatrefages, De St. Joseph, Fauvel).

When the branchiæ are removed, the anterior aspect of the *cephalic plate* presents in the middle the two somewhat triangular scars for the bases of the branchiæ, each surrounded by a rim, whilst between and beneath them is the central mass connected with the mouth. Dorsally a fillet trends forward on each side to join the prominent curved and acutely pointed dorsal folds of the collar, which form a continuous frill on the lateral and ventral edges. The branchiæ are barred with pink and green (Montagu), those, however, from Plymouth being tinted only with red.

Whilst a certain agreement exists between the cephalic region of *Protula* and the Sabellidæ, the tenacity with which the branchiæ cling to the basal tissue is characteristic of the Serpulids. In *Protula* the branchiæ form two comparatively short fans, the filaments in each of which range from thirty to sixty. They do not, as a rule, present a spiral arrangement in the preparations, though the tips are often coiled in various ways. Each filament springs from a basal web, which is elongated dorso-ventrally to accommodate the large series of these organs, and distally ends in a free subulate process (Plate CXXI, fig. 5), considerably longer, for instance, than in *P. intestinum*, and the short tip has a slight web on the inner side. The pinnæ are of moderate length and closely arranged in a double row along the inner border, the basal region of each being wider, and thereafter it gently tapers to the blunt tip. None of the camerated, chordoid tissue so characteristic of the Sabellid branchiæ is present either in filament or pinna, though it is probable that cellular supporting tissue must be in both. The filaments are best developed toward the dorsal edge of the fans. Toward the tip of the filament the pinnæ diminish in length and end in short papillæ at the base of the free distal processes, into which, as far as can be observed, only a blood-vessel enters. When thrown off, the vitality of the branchiæ is considerable.

A bilobed fillet lies between the bases of the branchiæ dorsally, and at its ventral edge is a triangular process. Ventrally a wide gap leads to the mouth, which has a short fissure in the lower lip. In the small variety from Herm the subulate process at the tip of the branchial filament and the pinnæ are proportionally shorter, but the structure is the same. The dorsal lip, ciliated and often bordered with brown, is placed between the first dorsal branchiæ, and carries two palps. This is separated from the mouth by the ventral lip, which is colourless.

The *body* (Plate CXVI, fig. 2) is somewhat broad anteriorly and tapers from the middle gradually to the tail, which has a terminal anus. It is somewhat flattened both dorsally and ventrally, a median groove occurring dorsally in the anterior region, and ventrally in the posterior region. The anterior region, moreover, has the broad membranous web continuous anteriorly with the dorsal fold of the collar, and which passes laterally above the bristle-tufts, ending ventrally by joining that of the opposite side behind the last bristle-

tuft of the region. This membrane is supported by a greatly developed alar or dorsal process of the foot, which tapers distally, and is freely mobile, so that when the annelid withdraws itself into the tube this membrane and the bristles are closely applied to the dorsum. No spine supports the alar process, so that the muscles of the bristles suffice for all its movements, which would appear to be partly respiratory, since its blood-vessels are finely reticulated.

The pore for the thoracic organs is placed on the second setigerous segment in the mid-dorsal line (De St. Joseph). The thorax is greenish, the alar membrane veined with green, and each segment is distinguished by a band of red. The first segment has two touches of orange or red (without crystalline elements), whilst the abdomen is reddish or orange.

The first region of the body, as a rule, consists of eight segments, viz., the peristomial and seven bristled segments. Moreover, as De St. Joseph pointed out, the first and the last have glandular scutes on the ventral surface, the first, in a line with the first bristle-tufts, being especially large. The first setigerous process and its bristles are usually directed differently from those which follow, viz., obliquely upward, forward and outward, the rest being in repose placed obliquely upward and backward. The bristles are somewhat shorter than those which follow and present more distinct, though very translucent and narrow wings. The typical anterior bristles (Plate CXXX, fig. 7) are pale golden and highly iridescent, long, slender forms, with straight shafts and but slight curvature of the finely tapered tips, the wings being so narrow as to be almost indistinguishable, only a linear streak indicating their presence on careful inspection. Such therefore differs from the condition in *P. tubularia*, where De. St Joseph describes and figures the wings as not only distinct but striated. The wings are also more distinct in *P. intestinum* from the Mediterranean. It is possible that friction modifies the wings in this region, and hence the more evident nature of these on the first bristle-bundles, which are less exposed.

The posterior region differs from that in *Protula intestinum*, for instance, since it presents no evident bristles to the naked eye or under a lens, for they are usually so closely adpressed as to escape notice, whereas in *P. intestinum* the posterior region has on each side a palisade of long glistening bristles. Such obscurity, however, is apparently due to friction, since in those best preserved similar though smaller bristles occur in this species (Plate CXXX, fig. 7a). Other tufts show only short shafts dilating gradually toward the distal end, which is curved, flattened, and translucent, the slender tips occasionally projecting beyond the surface.

The small variety dredged off St. Peter Port and found between tide-marks at Herm has somewhat better developed wings to its bristles, and the tips of the posterior bristles are more clearly scimitar-shaped, being curved backward like Syme's knife. In others the straight tips ended in sharp points, but whether such was due to injury or malformation is not at present clear.

The rows of hooks occur on the ventral side and behind the bases of the bristle-tufts in the anterior region, and consist of minute, thin, translucent organs (Plate CXXX, fig. 7a), which have a long anterior face ending inferiorly in a slightly curved spine corresponding to the main fang in other forms. The edges appear to be minutely serrated. The outline below the main fang forms a narrow gulf, and then trends to the thin basal plate. The posterior outline dips inward so as to make a prominent and bluntly conical

crown, and then joins the basal plate. The great number, transparency and delicate nature of these hooks are characteristic features. If Wollebæk's¹ figure of the hook of *Protula arctica*, Hansen, is correct, it differs from the foregoing in general shape, shortness of the main fang, large size and small number of teeth above it; indeed, there are five times the number in the British form.

The posterior hooks are smaller, but do not structurally differ from the anterior. They are situated on prominent lamellæ along the sides of the body, and toward the tail these are very closely arranged. The very minute serrations on the anterior face of these hooks is in contrast with the condition in *Protula intestinum*, and even with De St. Joseph's figure of *P. tubularia*.

Reproduction.—The males received from Plymouth on July 8th discharged a milky cloud of sperms and soon died. Claparède (1870) mentions that in *Psygmodranchus cæcus* the sexual elements completely filled the posterior region. In *P. tubularia* De St. Joseph met with red ova in the body-cavity. Lo Bianco (1909) procured the reddish ova in a gelatinous material near the mouth of the tube from April to August, most frequently from April to June.

The tube (Plate CXXI, fig. 6d) is long, round, white, and tapered, as well as more or less curved. It is marked by lines of growth which probably indicate the free anterior end at various stages of development. Those from Shetland and the Hebrides are fully 6 inches long. It appears to be free, for various forms are attached to it all round, such as Serpulids, Polyzoa, *Balani*, corals and Anemones. Montagu states that the smaller end is fixed, the rest (free) ascending at a considerable angle from the base, though rarely perpendicular. It keeps nearly the same diameter for a considerable distance toward the free end, showing that there is a limit to the size of the annelid. Occasionally the tubes are attached to each other. In the small littoral variety at Herm the tubes are fixed to the under surfaces of stones, or, when dredged, attached to the inner surfaces of bivalves. Langerhans (1884) mentions that, like Marion at Marseilles, he found the tubes with longitudinal ridges common at Madeira. The initial coil on a stone is sometimes lax, the tube rising in the water when an open coil or two are made. Occasionally on a shell the initial coil is close. The free tube is seldom straight, often curved in various ways. On a site apparently so congenial as the test of a large *Spatangus* at Naples two tubes, instead of rising upward, kept almost to the tip on the surface of the test.

It is probable that the *Protula intestinum* of Lamarck and others does not materially differ from the present form.

The *Protula borealis* of Sars may be this species.

Claparède (1868) found only a single *Protula* at Naples, viz., *P. intestinum*, but two species of *Psygmodranchus*. He draws attention to the distant halves of the ganglionic cord in *Psygmodranchus protensus*, and he thinks this an indication of inferiority, especially as in larval Annelids such a condition is more marked than in the adult. He found three pairs of ganglia in the thoracic region, the largest being the second. The ganglia are united by transverse commissures. In *Protula* the hypoderm is greatly developed on the ventral surface and richly vascular. He describes a pennate arrangement of the longitudinal

¹ 'Skript. Vid. Selsk. Krist.,' Bd. ii, No. 18, p. 120, pl. xlviii, figs. 6a and 6b.

muscles in *P. infundibulum*. In this species the intestinal sinus is lodged between the epithelial coat and the circular muscular fibres. Giant-fibres occur in its nerve-cord and oesophageal commissures.

Jaquet¹ (1886) gives an account of the circulation in *Protula intestinum*.

Lo Bianco (1893) describes two species of *Protula* from Naples, viz., *P. protula*, Cuvier, and *P. tubularia*, Montagu, the former having four pairs of eye-specks on the branchiæ, the latter with twenty to twenty-four simple eyes in double series on these organs. Moreover, *P. protula* is said to have no hooks on the thoracic region, whilst in *P. tubularia* they begin on the third segment. Further investigations of the two forms are necessary, especially in view of the variability of certain members of the Serpulidæ.

Fauvel² (1909) has shown that the young examples possess the bristles of *Apomatus* in the last two thoracic segments, but that they disappear in the adult. Further (1910), he has given a critical revision of this species, and finds that *Protula Meilhaci*, at Marseilles and Cette, of Marion, is the same form (*Protula tubularia*), as also is *Psygmodbranchus simplex*, De Quatrefages, and *P. intermedius*, Marion. Moreover, he deems it possible that the young *Protula tubularia*, which has lost its operculum, may have been confounded with *Apomatus* (e.g., *A. similis*), especially as young examples of *Protula* have *Apomatus*-like bristles in the posterior region of the thorax, these disappearing in the larger forms. Fauvel had examples from Killarey Harbour. It is possible that several foreign species, at present separated, may yet be linked on to the British form. There is a close resemblance in both bristles and hooks.

Genus CLXXVII.—FILOGRANA, Oken, 1815.

Reticulatum, Raius, 'Hist. Plant.,' i, p. 65; *Tubularia*, Plancus, 'de Conch.,' *Tubercularia*, Blainville, 'Dict. Sc.,' t. xlviii, p. 556 (errore typ.); *Tubipora*, Köhltreuter, 'Act. Petrop.,' vii, p. 374; *Tubipora*, Gmelin, 'Syst. Nat.,' p. 3754; *Filigrana*, Oken, 'N.G.,' 1815, p. 379, og Register VI; *Filigrana*, Agassiz, 'Nomenclat.,' p. 155; *Filigrana*, Berkeley, 'Zool. Journ.,' 1832; *Filipora*, Flem., 'Brit. An.,' 1828, p. 536; *Filigrana*, Philippi, 1844, 'Arch. f. Naturges.,' p. 196.

Cephalic plate with a collar open dorsally, a lateral fan-shaped flap on each side, and a broad ventral flap split except at the lamellæ. Four branchiæ at each side, the dorsal filament in each tuft bearing a thin ovate operculum or none. Body with seven or eight bristled segments anteriorly from the third backward, then a bare region, followed by another with slender bristles, lastly a bare region in front of the anus. Anterior bristles of two kinds, one with tapered knife-like tips, the other with broader, curved tips, having a serrated differentiation at the base.³ Anterior hooks (which, like the posterior, are in a single row) have a nearly straight anterior edge serrated throughout, and ending below in a main fang beneath which is a sulcus. The posterior hooks are smaller, but similar in structure. Multiplies by

¹ Op. cit., p. 362, pl. xxii, figs. 71—74.

² 'Assoc. Française,' 1909, Lille, p. 130.

³ Posterior bristles capillary falciform (Carus).

transverse fission as well as sexually. Tubes calcareous, more or less parallel and aggregate, white and cylindrical, often in large fenestrated masses.

The genus *Salmacina* of Claparède is here held to be synonymous. It is described as having similar branchiæ, with a circular basal membrane, no operculum; first thoracic segment bears larger capillary bristles than the succeeding; capillary bristles at the third segment are dentate on the margin; forms calcareous tubes in masses. This diagnosis answers equally for *Filograna*.

I. FILOGRANA IMPLEXA, *Berkeley*, 1827. Plate CXVI, figs. 5 and 5a—body and bud; Plate CXVII, figs. 2—2c—body, buds, tubes; Plate CXXI, fig. 8—tubes in mass; Plate CXXII, fig. 1—nephridia; Plate CXXXVII, figs. 20—20c and 21—bristles and hook.

Specific Characters.—Cephalic plate with four branchiæ on each side, the dorsal filament in each terminating in a thin ovate operculum or devoid of it, the others having short processes at the end. Pinnæ proportionally thick with rounded and often curved ends. Collar open dorsally, a lateral fan-shaped flap on each side, and a broad ventral flap split except at the base into two lamellæ. Two eyes on the dorsum of the cephalic region.

Body of about twenty-four segments, with seven to ten bristled segments anteriorly, the first pair of tufts on the third segment being directed forward and outward, the rest obliquely upward and backward. Then a region devoid of bristles occurs, followed by another with long slender bristles (usually two in each tuft), a bare region in front of the tail, and lastly a terminal anus with a rounded papilla at each side. Anterior bristles of two kinds, simple translucent bristles with straight shafts and tapered knife-like tips, and two others with curved and broader tips with a serrated differentiation at the base. The posterior bristles have very long tapering tips, with an enlargement at the commencement. Single, long rows of hooks below the bristles in front, and short rows above the bristles posteriorly. Hooks with a straight line of spikes above the main fang anteriorly, an incurvation and convexity below it, a crown sloping posteriorly to a short base.

Calcareous tubes, small, aggregate, white and cylindrical—forming masses 7 inches by 10 inches or more. Reproduction by budding posteriorly, as well as sexually.

Lamarck (1818) placed *Filograna* under his Serpulids, truly stating that its calcareous tubes were capillary, in bundles and permeated by spaces. It has a wide distribution, viz., from the Mediterranean to New Holland. Philippi,¹ again, criticised Lamarck's statement that there were eight tentacles, instead of two, but Lamarck evidently referred to the branchiæ.

SYNONYMS.

1697. *Rete marina*, Boccone. Museo di Fisica, p. 288, tab. ii, fig. 3; tab. vii, fig. 2.

1710. *Reticulatum trophaceum*. Ray List., i, p. 67.

1758. *Congerius minutorum tubulorum*, Seba. Thes., vol. iii, p. 189, pl. c, fig. 8.

1766. *Serpula filograna*, Linnæus. Syst. Nat., xii, p. 1265.

„ „ *corallifica*, Pallas. Zoophytes, p. 239.

¹ 'Archiv f. Nat.', 1844, p. 196.

1789. *Tubipora*. Act. Petrop., vol. vii, p. 374, tab. x, fig. 3.
 1806. *Serpula filograna*, Turton's Linn., p. 604.
 1815. *Clymene filograna*, Oken. Lehrb. Naturgesch., p. 379.
 1818. *Serpula* „ Lamarck. Anim. s. Vert., t. v, p. 364.
 1819. „ *complexa*, Turton. Conch. Dict., p. 153.
 1826. „ *filograna*, Payraudeau. Cat. Annel. Mollus. Corse, p. 21.
 „ „ *filigrana*, Risso. Hist. l'Europ. Merid., t. iv, p. 402.
 1827. „ *filograna*, = *Serpula complexa* (Turton), Berkeley. Zool. Journ., iii, p. 230, pl. xviii, fig. 3.
 1830. „ „ Bosc. Vers., 2nd Edit., vol. i, p. 208.
 1835. *Filograna implexa*, Berkeley. Zool. Journ., v, p. 427.
 1836. *Serpula filograna*, Scacchi. Cat. Conch. Regne Neapol., p. 19.
 1840. „ *intricata*, Grube. Echin. Actin. u. Würmer, p. 62.
 1846. *Filograna implexa*, Sars. Fauna Lit. Norveg., i, p. 86, Tab. x, figs. 12—22.
 1848. „ *Schleideni*, O. Schmidt. Neue Beiträge der Würmern, p. 33, Tab. iii, figs. 7 and 7a.
 1851. „ *implexa*, Sars. Reise, 1849, Nyt Mag., vi, pp. 132 and 204.
 „ „ „ Grube. Fam. Annel., p. 94.
 1853. „ „ Sars. Nyt Mag., vii, p. 390.
 „ *Filipora filograna*, Dalyell. Pow. Creat., vol. ii, p. 250, pl. xxxiv, figs. 1—6.
 1857. *Filograna implexa*, Koren. Nyt Mag., ix, p. 94.
 1859. „ „ Danielssen. Kgl. Norske Vid.-selsk. Skrift., 4^{de} Bd., Reise, 1858, p. 124.
 1861. „ „ idem. Reise, 1857, Nyt Mag., xi, p. 56.
 „ „ „ Mörch. Rev. Serp., p. 18 (364).
 „ *Filigrana Schleideni*, idem. Ibid., p. 19 (365).
 1862. *Filograna implexa*, Keferstein. Zeitschr. f. wiss. Zool., xii, p. 128, pl. xi, figs. 23, 24.
 1863. „ „ and var. *Sarsi*, an n.s., Mörch. Nat. Tidsskr., iii, p. 384.
 „ *Protula Dysteri*, Claparède. Beob. über Anat. u. Entwicklung., p. 31, pl. xv, figs. 16—23.
 1864. *Filograna implexa*, Sars. Forh. Vid.-selsk. Christiania, p. 6.
 1865. *Filograna implexa*, Johnston. Cat. Worms Brit. Mus., pp. 273 and 347.
 „ „ „ De Quatrefages. Annel., ii, p. 487.
 1867. *Filigrana* „ Malmgren. Annul. Polych., p. 119.
 „ *Filograna* „ Parfitt. Cat. Annel. Devon, p. 36.
 1868. *Salmacina incrustans*, Claparède. Annél. Nap., p. 436, pl. xxx, fig. 5.
 1870. „ *œdificatrix*, idem. Suppl. Annél. Neap., p. 155, pl. xiii, fig. 1.
 1874. *Filigrana implexa*, Malm. Annel. Göteb., p. 102.
 „ *Filograna* „ McIntosh. Ann. Nat. Hist., ser. 4, vol. xiv, p. 206.
 1875. *Salmacina incrustans*, and *œdificatrix*, Panceri. Atti Soc. Ital., vol. xviii, p. 535.
 „ *Filograna implexa*, McIntosh. Invert. and Fishes St. Andrews, p. 131.
 1876. *Salmacina Dysteri*, Giard. Compt. Rend., 17 and 23 Jany.
 1878. *Filograna implexa*, Storm. Kong. Norske Vid.-selsk. Skrift., p. 233.
 1879. *Filigrana* „ Tauber. Annul. Danica, p. 138.
 1883. *Filograna* „ Levinsen. Vidensk. Meddels., p. 197, pl. ii, fig. 8 a, b.
 1884. *Salmacina australis*, Haswell. Proc. Linn. Soc., N.S.W., vol. ix, p. 21, pl. xxxiii, figs. 7—11.
 1885. *Filograna implexa*, Carus. Fauna Medit., i, p. 279.
 1886. „ „ Harvey Gibson. Proc. Lit. and Philos. Soc. Liverp., vol. xl, p. 160.
 1887. *Filigrana* „ Webster. U.S. Com. F. and F., p. 751.
 „ „ *Huxleyi*, Ehlers. Florida Annel. Mem. Mus. Comp. Zool. Harvard, xv, p. 314, taf. lvi, figs. 4—9.

1888. *Filograna implexa*, Cunningham and Ramage. Trans. Roy. Soc. Edin., vol. xxxiii, p. 673, pl. xlv, fig. 35.
1889. „ „ Grieg. Bergens Mus. Aarb., p. 8.
1890. *Salmacyna Dysteri*, Malaquin. Annél.-Boulon., p. 49.
1891. *Filograna implexa*, Hornell. Trans. Biol. Soc. L'pool, vol. v, p. 264.
1893. *Salmacina incrustans*, Marenzeller. Polych. Grundes, p. 15.
- „ *Filograna implexa*, Levinsen. "Hauch's" Tog, p. 364, pl. lvi, figs. 4—9.
- „ *Salmacina edificatrix*, Lo Bianco.¹ Atti Accad. Sc. Nap., p. 91.
1894. *Filograna implexa*, De St. Joseph. Ann. Sc. nat., 7^e sér., t. xvii, p. 335, pl. xii, figs. 366—369, et pl. xiii, figs. 370—374.
- „ *Salmacina Dysteri*, idem. Ibid., p. 340, pl. xiii, figs. 375—380.
- „ *Filograna implexa*, Bidentkap. Christ. Vid.-selsk. Forhandl., p. 137.
1895. *Filogranes et Salmacines*, Malaquin. C. R. Acad. Sc. Paris, t. cxxi, p. 953.
1896. *Filograna implexa*, Roule. Camp. "Caudan," p. 465.
- „ *Salmacina edificatrix*, idem. Ibid., p. 466.
1897. *Filograna implexa*, Michaelsen. Polych. deutsch. Meere, p. 184.
1903. *Salmacina dysteri*, Malaquin. C. R. Acad. Sc. Paris, t. cxxxvi, p. 389.
1904. *Filograna implexa*, Journ. M. B. A., vol. vii, p. 232.
1906. „ „ De St. Joseph. Ann. Sc. nat., 9^e sér., t. iii, p. 248.
1907. *Salmacina dysteri* (Reprod. asexual), Malaquin. C. R. Assoc. Anatom., 9th Réunion, Lille, p. 172.
1908. „ *Dysteri*, Gravier. Nouv. Arch. Mus. d'Hist. Nat., t. x, p. 119.
- „ „ „ Ehlers. Deutsch. Tiefsee Exped., p. 161.
1909. „ *edificatrix*, Lo Bianco. Mitt. Zool. Stat. Neap., Bd. xix, p. 586.
- „ „ *incrustans*, Fauvel. Bull. Inst. Oceanogr., cxlii, p. 52.
- „ „ *Dysteri*, idem. Ibid., p. 52.
- „ „ „ idem. Ann. Sc. nat., 9^e sér., t. x, p. 210.
- „ *Filograna implexa*, idem. Bull. Inst. Oceanogr., cxlii, p. 51.
- „ „ *filograna*, Percy Moore. Proc. U.S. Nat. Mus., vol. xxxvii, p. 145.
1911. „ *implexa*, Riddell. Proc. Liverpool Biol. Assoc., vol. xxv, p. 65.
- „ *Salmacina dysteri*, idem. Ibid.
- „ „ *Dysteri*, Fauvel. Bull. Inst. Oceanogr., No. 194, p. 38.
1912. *Filograna implexa*, Crawshay. Journ. M. B. A., vol. ix, p. 347.
- „ „ „ McIntosh. Rep. Brit. Assoc., 1912, p. 514.
- „ *Filograna* „ Wollebæk. Skrift. Selsk. Krist., Bd. ii, No. 18, p. 111, pl. xl, figs. 1—6, pl. li, fig. 1.
1914. *Filograna* „ Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 147.
- „ *Salmacina incrustans*, Fauvel. Camp. Scient. Monaco, xlvi, p. 308, pl. xxx, figs. 26, 27.
1915. *Filograna implexa*, Allen. Journ. M. B. A., vol. x, p. 644.
1917. „ „ Rioja. Anél. Poliq. Cantáb., p. 81.
- „ *Salmacina Dysteri*, Fauvel. Arch. Zool. Expér., t. lvi, p. 271.
1920. *Filograna implexa*, Eliason. Polych. Öresund, p. 80.
- „ *Salmacina Dysteri*, Pixell. Scott. Antarct. Exped., vol. vii, p. 90.

Habitat.—Abundant off various parts of the British shores from Shetland to the Channel Islands, and generally in deep water. Large masses are dredged off St. Andrews Bay near the Bell Rock and outward to the "Long Forties" (E. M.). The masses are fixed to various

¹ His sole distinction is the numerous minute teeth of the first bristles.

submarine structures, such as valves of *Cyprina Islandica*, or to the aperture of *Buccinum undatum*. Weymouth (Berkeley), forming a thick lining to dead oyster-shells in southern waters; in masses attached to the base of Alcyonarian corals. Common on shells dredged in 12—20 fathoms off St. Peter Port, Guernsey. The flat surface of such shells as *Pinna* also form a favourite resort for the thin thread-like tubes, which form a network over large areas. Forth (Cunningham and Ramage). Clew Bay (Southern). Plymouth (Allen). It is cosmopolitan, extending to the Azores (Fauvel, *partim*). Three hundred fathoms, off Norway, Lofoten and Finmark, Sars; Faerøe Islands (O. Schmidt); shores of France (De Quatrefages, De St. Joseph, Fauvel), Mediterranean (Grube, Verany), Atlantic Coast, U.S.A. (Verrill), Gulf St. Vincent, Australia (Fauvel), and extends also to the Red Sea (Crossland), Tortugas (Ehlers), Indian Shores (Annandale), and Augener thinks Haswell's *Salmacina Australis* the same. Gough Island and Antarctic region (Pixell). Vald-stat. 4 (Ehlers); Northern Seas (Wollebæk); shores of Cantabria (Rioja). Marenzeller found *Salmacina incrustans* in deep water in the Adriatic; 390 m., Finmark (Norman); N.E. America (Moore).

The *cephalic region* presents a smooth gap between the rounded ends of the lamella forming a border to the anterior division of the body. A little below the edge of the lamella on each side is a flattened process of the collar which expands considerably distally so as to form a conspicuous structure. Ventrally the collar in the preparations folds backward as a broad lamella split distally into two lobes, which in all probability are directed forward when in the tube. Two eyes occur on the dorsum of the peristomial segment. Each consists of rounded pigmented spherules ("crystallins," De St. Joseph), numbering in the one seven, and in the other eye ten, though these may vary.

The branchiæ are eight in number, four on each side, and in the spirit-preparations are about half the length of the body. Each consists of a tapered filament with a somewhat camerated axis of what De St. Joseph calls mucous cells (giving a transversely barred aspect), which have not the differentiation of the Sabellid axis, and become indistinct in mounted preparations. The long diameter of these cells is about $\frac{1}{2500}$ of an inch, their short diameter being less. A double row of proportionally thick pinnæ is attached to the inner edge, each pinna having a central axis of similar structure to that of the filament, and the tip is bluntly rounded and often curved. The distal pinnæ diminish in length, the last being a mere papilla, and the filament ends in a short, smooth process often slightly clavate in spirit, and more opaque than the rest. Moreover, the dorsal filament on each side terminates in a thin, flattened, and somewhat ovoid plate, the pair performing the function of an operculum. In others these are absent, and the tips of the filaments are more less modified and enlarged, the granular cells in the enlarged tips being arranged in a somewhat regular manner, and often hexagonal in outline. In fresh examples the pinnæ present a double row of rough granular cells (mucous cells, De St. Joseph), set in a hyaline matrix, and in some views these have a spiral arrangement.

In an example a pair of elongated glandular sacs (nephridia ?) occurred in front of the sixth bristle-tuft of the anterior region in the coelom, the tips crossing each other (Plate CXXII, fig. 1). In structure they were granular. The intestinal canal is dilated behind the anterior region (seventh bristle-tuft), and runs as a straight tube from end to end. No diatoms or radiolarians were found in it, only brownish granules and sand-particles. The

colour is translucent orange, with the intestine dusky brown. It tints the tube, so that it has a faint reddish hue when the animal is within. The branchiæ are pale.

The first region of the *body* has seven or eight pairs of bristle-tufts, which, with the peristomial segment, make a total of eight or nine. The second region has from thirty-five to forty segments. The body is somewhat flattened both dorsally and ventrally, with a median groove in the posterior region on both surfaces, and terminates posteriorly in an anus, which has a prominent papilla at each side, and this, according to De St. Joseph, may assist in the formation of the tube. The anterior region has the alar membrane stretching from the collar along each side to the posterior edge of the last segment of the anterior region, where it bends ventrally and fuses with that of the opposite side as in *Protula*, leaving a free flap posteriorly. It forms a more uniform margin than in *Protula*, and is in the preparations generally directed obliquely upward and outward, the bristle-tufts being beneath, and so closely applied as to appear to be oblique rays supporting it.

The first or collar bristle-tuft is directed outward and forward, and the bristles have translucent straight shafts, and a knife-shaped, tapered tip, with a broader and coarsely serrated base and a differentiation or "bite" at the edge of the blade, the serrations on the distal region being so minute as to be almost indistinguishable (Plate CXXXVII, fig. 20). From this simple or less boldly developed form the increase in the size of the basal and distal serrations may be followed, to culminate in the highly developed condition in *Salmacina incrustans* and *L. ædificatrix* of other authors. The six pairs of bristles which follow slope upward and backward, have similar translucent straight shafts, but the tapered tips, which are bent at a slight angle (geniculate), are more slender. Moreover, the presence of sickle-shaped bristles (Plate CXXXVII, fig. 20a), about two in each tuft, is a noteworthy feature.

The second region of the body is devoid of bristles for a short distance, whilst the posterior part has them in pairs, the tips being long and finely tapered, with distinct wings (Plate CXXXVII, fig. 20b).

The minute, translucent, anterior hooks (fig. 20c) have a nearly straight anterior edge serrated throughout and ending below in a main fang, the outline being continued with a curve below the hook and terminating at the basal edge. The crown is minute and the posterior outline slopes to the base, which appears to have a straight edge. The rounded projection below the main fang shown by De St. Joseph in *Filograna implexa* differs from that of the present examples. These hooks are situated slightly behind and to the ventral side of the bristles, and form considerable rows. The posterior hooks are smaller, but agree in structure with the anterior. They are placed on the dorsal side of the bristle-tufts, and are few in number in each row. Like those of its allies, these minute, thin hooks cling together so closely that it is difficult to get a lateral view of a single hook.

Reproduction.—The eggs are red, and the embryos resemble those described for *Salmacina Dysteri*. The spermaries seem to develop a little later than the ovaries, none, indeed, appearing in the bud, but by-and-by they fill the non-bristled region in front of the ovigerous segments, and bulge laterally, the region being thus characterised by its pallor.

Early trochophores of a deep red colour occurred in the glass vessels of sea-water on the 9th June, the prototroch being visible on each side. They simply rotate or swim in small circles, but the larvæ with commencing segmentation of the body dart through the water with great vigour, and often in a straight line, whilst others make larger circles near

the bottom. One of the latter showed three segments behind the head, and in all the two eyes were distinct.

The masses of tubes (Plate CXXI, fig. 8) formed by this species are often of large size—nearly a foot square—showing that by rapid budding it can hold its own in the struggle for existence—probably quite as effectually as in the case of those with numerous ova, these being few. The notion that the character of the tubes as to closeness and divarication may indicate specific distinction is uncertain. Much will depend on freedom from injury in the living or dead condition and the site inhabited.

In considering the relationships of the various races of *Filograna* little can be added to what has been published lately.¹

No form in the whole range of the Polychæts is of greater interest than this species, the life-history and reproduction of which, its plastic and protean character, as well as the concrete calcareous masses, often of considerable size, formed by its thread-like tubes, combine to surround it with a halo of interest were it only for the study of variability in a single type. Moreover, in genial waters it flourishes with a profusion which sometimes causes considerable inconvenience; thus Mr. Chadwick, at the Port Erin Biological Station, found that the flow in a supply-pipe from a tank was gradually diminishing, and on investigation a vigorous mass of *Filograna* was found blocking the lumen.

Seba² (1758), in alluding to various marine “mosses, corallines,” and tubular corallines, which he figures, specially refers to this species, which he found adherent to rocks and various structures, in one instance forming the basis (fig. 19a) to which *Thuiaria thuja* was attached. In the “Thesaurus” he gives a figure in which the spaces between the fascicles of tubes are correctly represented.

Nothing definite appears in the remarks of Plancus’ “*De conchis minus notis*” bearing clearly on this form, though he is quoted by some authors.

Berkeley³ (1827) described the form with the opercula which he dredged at Weymouth. The same author in the ‘Zool. Journ.’ gives a figure (Plate XVIII, fig. 3) which is in the volume of supplementary plates (and not in vol. iii), showing a somewhat pointed hollow operculum on each dorsal filament, seven pairs of thoracic bristles, and in the posterior region indication of a twist, or it may be a bud.

Oscar Schmidt⁴ (1848) alludes to *Filograna implexa* and states that he has found a new species at Farøe—with buds at all stages—such, however, being only a phase in the common form.

Salmacina, Claparède states (1868), is distinguished from *Protula* by the large bristles of the first segment—a character in which it approaches the Serpulids and *Filograna*. The absence of an operculum, however, separates it from both.

There is nothing in the structure of *Filograna Huxleyi*, Ehlers, from the Tortugas, to indicate other than a variety of a species with world-wide distribution. The bristles and the tips of the branchiæ fall into line when compared with those of *Salmacina incrustans* and *S. œdificatrix*.

¹ “Studies on *Filograna*,” ‘Ann. Nat. Hist.’ ser. 9, vol. iii, January, 1919, p. 125.

² Catalogue of the curiosities in the cabinet of Albertus Seba.

³ Pl. xviii, fig. 3, absent from the University copy of the ‘Zoological Journal.’

⁴ ‘Frørieps Notizen,’ No. 143, p. 162, August.

De St. Joseph (1894) describes four phases of *Salmacina Dysteri* as follows :—

1. The hermaphrodite animal without buds, and 6 mm. long, with the first abdominal segments bearing the male and female elements, the segments following being filiform, and the last enlarged.

2. A short animal of twenty abdominal segments, without the filiform portion of the abdomen, and which prepares for budding, or perhaps “ayant déjà bourgeonné s’est reconstitué les segments détachés.”

3. An animal of the same size as the preceding, having a bud at the eighth or ninth abdominal segment.

4. Animal shorter than the foregoing, in which the bud is detached, and the nine or ten segments of the abdomen remain; no eyes. In all four cases the thoracic region is the same—indifferently of seven to nine segments. It is the abdominal region which varies.

In *Filograna implexa* the extremities of two branchiæ are transformed into opercula. Fritz Müller describes a small Serpulid with six branchiæ like *Protula*, which acquires an operculum on one of the branchiæ, yet retaining its barbules, which afterwards disappear, and the whole resembles the peduncle of a Serpulid operculum. De St. Joseph had not seen this. *S. Dysteri* shows no tendency to form an operculum. Other views are held in the present work, and there is nothing of moment in the foregoing to indicate a different species.

The sexual and asexual phases in the Salmacinæ are thus described by Malaquin¹ :—

1. Protandrous young condition: The male genital organs are in the thorax, and then it becomes sterile.

2. The phase of asexual reproduction or schizogamy: During this period certain individuals present few and incompletely developed male elements.

3. The hermaphrodite phase: The male and female elements are in distinct segments, the male in two to four of the anterior abdominal segments, the female in eight to ten of the following segments.²

Ova and larvæ were found in the tubes of *Salmacina œdificatrix* from October to June by Lo Bianco (1909) at Naples, as well as many individuals in gemmation. This form occurs in deep water (100 metres). *S. incrustans*, on the other hand, he found on stones with littoral algæ, and eggs and larvæ besides abdominal buds occurred from July till October. He distinguished the species (1893) by the larger size of *S. œdificatrix*, the presence of eight to ten setigerous segments in the thorax, and by the absence of the teeth on the web at the base of the tip of the collar bristles. He probably implies that the web has finer serrations. He found masses of the tubes of *S. œdificatrix* 20 cm. in diameter.

Fauvel (1909) thought *Salmacina incrustans* synonymous with *Serpula intricata*, Grube, and *Serpula filograna*, Scacchi, and that the structure of the first series of bristles agreed with Claparède’s form—having coarse crenulations at the base of the wing, but such changes in the size of the serrations in the bristles and the variations in the branchiæ do not have specific weight in a form so variable. This author’s figure shows only four serrations on

¹ ‘Assoc. Française,’ 1909.

² The hermaphrodite forms in Serpulids amongst others are those given by Claparède (1868)—*Laonome*, *Salmacina*, *Pileolaria*. Lo Bianco enters *Amphiglena*, *Salmacina*, *Spirorbis* and *Pileolaria*, whilst fissiparous reproduction occurs in *Salmacina* and *Telepsavus* (Malaquin).

the basal web, and none on the distal region of *Salmacina incrustans*, whereas those kindly sent by him presented from five to seven serrations on the basal web.

MM. Caullery and Mesnil¹ (1905) found a Haplosporidian parasite (*Haplosporidium marchonice*) in *Salmacina Dysteri* from Cape Hague and Wimereux in great abundance in the coelom.

Malaquin² (1909) mentions that round the gut is a vast sinus formed by the supra-intestinal. In *Salmacina* it lies between the coelomic epithelium and the intestinal epithelium. He thinks that this sinus represents the primitive blastocoel.

Arnold Watson (in lit., 1916) found two opercula in a *Filograna*-like Serpulid—on opposite branchial filaments (each the central branch of the tuft). The new one resembled a shallow cup, and the old one was thrown off.

Dr. Crossland finds *Filograna* common on the ships' bottoms in the Red Sea, but, apart from this artificial habitat, he rarely sees it. Seamen invariably term it coral.

Genus CLXXVIII.—HYDROIDES, *Gunner*, 1768.

Cephalic collar separated posteriorly, and fused with the alar membrane. It trends to the ventral surface, where it forms a bifid median membrane. Branchiæ of moderate length with short terminal processes. Dorsal filament on each side modified into a complete or a rudimentary operculum, the complete having two tiers, the upper a radiate vase-like apparatus of spiked horny rays, the lower a crenate vase of tough cutaneous tissue. Calcareous coiled tube, cylindrical, marked by lines of growth, and colonial.

1. HYDROIDES NORVEGICA, *Gunner*, 1768. Plate CXVI, fig. 3—body; Plate CXXI, figs. 6—6c—body, tubes and opercula; Plate CXXX, figs. 9—9c—bristles and hooks; Plate CXXXI, fig. 10—extremity of branchial filament; Plate CXXXIII, figs. 1 and 1a—tubes and rudimentary operculum.

Specific Characters.—Tube coiled, cylindrical, marked only by lines of growth; often in masses. Cephalic collar separated posteriorly and fused with the alar membrane. The collar trends to the ventral surface, where it forms a bifid median membrane. Branchiæ fifteen to eighteen, variegated with pink; filaments of moderate length, with short terminal processes; pinnæ of moderate length, slightly tapered distally. Dorsal filament on each side modified into a complete or rudimentary operculum of two tiers, the upper a beautifully radiate vase-like apparatus of spiked horny rays sixteen to twenty in number, the lower a crenate vase of twenty-five to twenty-seven divisions, the whole attached by a long stalk. The rudimentary organ has a short stalk and a clavate tip. Body of a reddish orange colour, with a pale alar membrane in front, rounded dorsally, slightly flattened ventrally, and with a median groove from end to end, tapered posteriorly and ending in a bilobed anus. Anterior region of seven bristled segments, the first pair directed upward and forward

¹ 'Compt. rend. Soc. Biol.,' t. lviii, p. 581.

² 'Assoc. Française,' 1909, p. 135.

and separated by a distinct interval, whilst its peculiar bristles are diagnostic. These have a shoulder at the end of the shaft, followed by a long whip-like process and two short processes (horns). Amongst these are more slender, tapering bristles, with serrated tips. The other six bristle-tufts are simple with serrated and tapered tips. Posterior region of seventy segments or more, bare anteriorly, but with very slender long tapering bristles posteriorly in nine to eleven segments. Anterior hooks form a polygon, with six teeth above the main fang; posterior hooks with a longer posterior outline and four teeth above the chief fang. The *tube* forms smooth white coils, marked only by the circular lines of growth, which give a barred appearance. Small end turned contrary to the rest of the tube. Often in groups.

Philippi (1844) seems to have had little acquaintance with this type, which he placed under his genus *Eupomatus*.

SYNONYMS.

1739. *Serpulid*?, Rumphius. Thesaurus Pisc. Test., pl. xli, fig. 4.
 1758. *Serpula intricata* and *contortuplicata*, Linnæus. Syst. Nat., 10th Edit., p. 787.
 „ *Tubuli vermium*, Seba. Thesaurus, Tab. xciii, fig. 3.
 1767. *Tubuli alii parvi*, Jonston. Exsang., Tab. xvii?
 „ *Serpula intricata*, Linnæus. Syst. Nat., xii, p. 1265.
 „ „ *contortuplicata*, idem. Ibid., p. 1266.
 1768. *Hydroides norvegica*, Gunnerus. Norske Vid.-Selsk., iv, pp. 52—3, pl. ii, figs. 11—13.
 1769. “*Tubuli viscera avium*,” Martini. Conch., i, pp. 25, 64, Tab. iii, fig. 23.
 1770. *Antalium*, Guettard. Mém. Différ. Parties Sc. et Arts, iii, p. 74, pl. lxix, fig. 1.
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 1777. „ *vermicularis*, Pennant. Brit. Zool., p. 146, Tab. xciv, fig. 2.
 „ „ *intricata* and *reversa*, idem. Ibid., Tab. xci, fig. 158.
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 1780. *Serpula contortuplicata*, O. Fabricius. Fauna Grœnl., p. 381.
 1789. „ *vermicularis* (*partim*), O. F. Müller. Zool. Dan., iii, p. 9, fig. 9.
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 1803. „ *tubularia*, Montagu. Test. Brit., ii, p. 513, and Suppl., p. 171?
 1806. „ *contortuplicata*, Turton's Linn., p. 604.
 „ „ *intricata*, idem. Ibid., p. 604.
 „ „ *norvegica*, idem. Ibid., p. 607.
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 „ „ „ Montagu. Test. Brit., p. 508.
 „ „ *tubularia* and *reversa*, Maton and Rackett. Linn. Trans., viii, p. 244.
 1817. „ *contortuplicata*, Dillwyn. Descr. Cat., p. 1076.
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 „ „ „ Cuvier. Règne Anim., t. ii, p. 518.
 1818. *Serpula vermicularis*, Lamarck. Anim. s. Vert. t. v, p. 362, var. B.
 „ „ *intestinum*, idem. Ibid., t. v, p. 363.
 1819. „ *vermicularis*, Turton. Conch. Dict., p. 152, var. A and C.
 1820. *Serpula contortuplicata*, Savigny. Syst. Annel., p. 73.
 1824—33. „ „ Griffiths. Transl. Cuvier, vol. xiii, p. 10, pl. viii, fig. 1.

1825. *Heterodisca reversa*, Fleming. Edin. Philos. Journ., xii, p. 248.
 „ *Vermilia intricata*, idem. Ibid., xii, p. 242.
 1826. *Serpula contortuplicata*, Risso. Hist. l'Europ. Mer., t. iv, p. 402.
 „ „ *intricata*, idem. Ibid., t. iv, p. 403.
 „ „ *contortuplicata*, Payraudeau. Cat. Annel., Mollusca, Corse., p. 21.
 1827. „ *tubularia*, Berkeley. Zool. Journ., iii, p. 229, and Suppl., pl. xviii, fig. 2.
 „ „ *contorta*, Brown. Illust. Conch., pl. ii, fig. 4.
 „ *Vermilia triquetra*, idem. Ibid., pl. ii, fig. 1.
 1828. *Serpula intricata*, De Blainville. Dict. Sc. nat., t. lvii, p. 428.
 1830. „ *contortuplicata*, Bosc. Vers., vol. i (2nd Edit.), p. 206.
 „ „ *intricata*, idem. Ibid., vol. i (2nd Edit.), p. 208.
 1834. „ *Mulleri* and *tubularia*, Berkeley. Loud. Mag. Nat. Hist., p. 421.
 1836. „ *contortuplicata*, Templeton. Ibid., p. 233.
 1840. „ *intricata*, Grube. Actin. Echin. u. Würmer, p. 62.
 1844. „ *contortuplicata*, Ersted. Nat. Tids., ser. 2, i, p. 414.
 „ *Eupomatus pectinatus*, Philippi. Archiv f. Nat., Bd. x, p. 195, fig. R.
 „ „ „ idem. Ann. Nat. Hist., xiv, p. 160, pl. iii, fig. 2.
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 1851. „ *vermicularis*, Sars. Reise, 1849, Nyt Mag., vi, pp. 204 and 205.
 „ *Eupomatus pectinatus*, Grube. Fam. Annel., pp. 91 and 142.
 1853. *Serpula contorta* (*partim*), Dalyell. Pow. Creat., vol. i, p. 85, pl. xx, figs. 1—6.
 1859. „ *vermicularis*, Danielssen. Kgl. Norske Vidensk. Selsk. Skrift., 4^{de} Bd., 2^{det} Heft, p. 124.
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 1864. „ „ idem. Insel Lussin, p. 91.
 1865. *Serpula contortuplicata*, De Quatrefages. Annel., t. ii, p. 560.
 „ „ *reversa*, Johnst. Cat. B. M., pp. 270 and 346, pl. xx, fig. 6.
 1867. „ *intricata*, Parfitt. Cat. Annel. Devon, p. 35.
 „ *Hydroides norvegica*, Malmgren. Annul. Polych., p. 120.
 1870 ?. *Eupomatus trypanon*, Claparède. Suppl. Ann. Nap., p. 163, pl. xiv, fig. 4.
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 1874. *Hydroides norvegica*, Malm. Annel. Göteb., p. 102.
 „ „ „ McIntosh. Ann. Nat. Hist., ser. 4, vol. xiv, p. 206.
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 „ *Eupomatus pectinatus*, Marion. Annél. Marseill., Rev. Sc. nat., t. iv, p. 311.
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 „ „ *pectinata*, idem. Ibid., p. 139.
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 1885. „ *pectinata*, Carus. Fauna Medit., i, p. 276.
 1889. „ *norvegica*, Grieg. Bergens Mus. Aarb., p. 8.
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 1891. *Hydroides norvegica*, Appellöf. Bergens Mus. Aarb., p. 8.
 1893. *Serpula Philippi*, Lo Bianco. Atti R. Accad. Sc. Nap., vol. v, No. 11, p. 82.
 „ „ *aspera*, idem. Ibid., vol. v, No. 11, p. 82.
 „ *Hydroides uncinata*, idem. Ibid., vol. v, No. 11, p. 84.

1893. *Hydroides lunulifera*, idem. Ibid., vol. v, No. 11, p. 85.
 „ „ *pectinata*, idem. Ibid., vol. v, No. 11, p. 85.
 „ „ *norvegica*, Marenzeller. Denks. Akad. Wiss. Wien, lx, p. 19, pl. iv, fig. 18.
 „ „ „ Levinsen. "Hauchs" Togter, p. 354.
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 1896. „ *uncinata*, Orlandi. Atti Soc. Ligust. Sc. Nat., vol. vii, p. 158.
 „ „ *norvegica*, Appellöf. Berg. Mus. Aarb., xiii, p. 12.
 1897. „ „ Michaelsen. Polych. deutsch. Meere., p. 186.
 1898. „ „ De St. Joseph. Ann. Sc. nat., sér. v, p. 440, pl. xxiii, fig. 248.
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 1912. *Hydroides norvegica*, Crawshay. Journ. M. B. A., vol. ix, p. 347.
 „ „ „ Wollebæk. Skrift. Selsk. Krist., Bd. ii, No. 18, p. 115, pl. xliii, figs. 1—6 ;
 pl. xlv, fig. 1 ; pl. l, fig. 5.
 1913. ? „ *uncinatus*, Ehlers. Deut. Sud.-Pol. Exped., p. 582.
 1914. ? *Eupomatus uncinatus*, Treadwell. Univ. California, Zool., vol. xiii, p. 225.
 „ *Hydroides norvegica*, Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 147.
 „ „ „ Fauvel. Campag. Scient. Monaco, xlvi, p. 324, pl. xxxi, fig. 25.
 1915. „ „ Allen. Journ. M. B. A., vol. x, p. 644.
 „ *Serpula vermicularis*, Southern. Irish Sc. Invest., No. 3, p. 49.
 1917. *Hydroides norvegica*, Rioja. Anél. Poliq. Cantáb., p. 80.

Habitat.—Abundant in deep water all round the British shores attached to shells and stones as well as in the Laminarian zone. Under stones between tide-marks, Herm. On shells and laminarian roots, Lochmaddy (W. C. M.).

Plymouth (Spence Bate and B. Rowe, Crawshay); Dublin Bay and West Coast of Ireland (Southern). Cosmopolitan. Persian Gulf (Gravier, Fauvel); Northern Seas (Wollebæk); Greenland (Ditlevsen). Is found in Sweden, Norway (fixed to *Amphihelia prolifera*, Kröyer) and Finmark (Malmgren); Mediterranean (Delle Chiaje, Grube, Philippi, Claparède, Panceri, Marion); shores of France, De St. Joseph; Adriatic (Marenzeller); shores of Cantabria (Rioja).

The prominent dorsal edges of the collar of *Hydroides norvegica* are supported by the first bristle-bundles, a considerable gap, however, occurring in the mid-dorsal line. It then passes ventrally to expand into a large thin lamella sloping on each side to a median notch, so as to be more or less bilobed, and is either reflected backward or stretched forward on the base of the branchiæ.

The branchiæ (Plate CXVI, fig. 3) form two well-marked fans of fifteen to eighteen filaments, the dorsal filament in addition on each side being modified either into a complete or a rudimentary operculum, and it seems to be immaterial which side develops the complete organ, since it is sometimes the one and sometimes the other. The branchial filaments are of moderate length, and taper distally to end in a short subulate process, often concealed

when coiled. No special chordoid or other axial structure is present, but the cuticle is very thick. The pinnæ are rather short, devoid of a special stiffening apparatus, and extend to the tip, partially overlapping the terminal process. They taper a little from base to apex. In life the branchiæ are spotted with crimson and have a pinkish hue from the colour of the pinnæ.

The pedicle of the operculum has a transparent but tough investment of a cellular membrane (mainly hexagonal). Internally is a yellowish fibro-granular and apparently muscular cylinder in the preparations. The distal funnel or wheel of the operculum is brownish, horny, and when viewed from above has somewhat the aspect of a Chinese umbrella, with a fissured and spinous rim of sixteen to twenty or more processes. Moreover, the upper surface of the wheel is armed with spikes (Plate CXXI, figs. 6 and 6*b*), which form a series of rings round the central area. In lateral view it is vase-shaped, with a graceful inclination outward and upward from the narrow stem. Each of the rays forms a stout, tapering process, terminated by a thin flexible tip, each side being armed with three or four stiffer and shorter spines, a double contour being visible for fully the basal half. The longest lateral spines are, as a rule, the distal pair, since they have a wider area to guard. This elegant horny apparatus takes the place of the calcareous operculum of other forms, and the flexible tips of the rays apparently yield to a certain extent in withdrawal into the tube, causing the spines to approach each other more closely, and thus efficiently protecting the aperture. In some large examples the dorsal and lateral spikes are bifid; various smaller spikes occur in the intervals, and an imperfect ray is intercalated between two of the others.

The second tier of the operculum (Plate CXXI, figs. 6*b* and 6*c*) forms a gracefully fluted cup, with about twenty-seven crenations, each separated from its neighbour by an involution of the tough integument enclosing hypodermic cells and granules. The muscular fibres in the centre of the stem expand as they approach the lower operculum, on the centre of which they pull, and so fix the elastic crenate margin on the sides of the tube. The protection of the aperture is thus doubly secured, for the distal spinous shield closes over the crenate cup and exposes only the tough spiny rays to an aggressor. It requires great force to detach this cup from the opercular stalk, apparently from the toughness of the cuticle. The rudimentary organ of the other dorsal edge is often minute, resembling a *Loxosoma*, and springs from the fan near the base of the first filament of the sides, frequently the left dorsal filament of the branchial fan (Plate CXXXIII, fig. 1). It has the form of a stout pedicle, tapering a little distally, and having the small truncated operculum at the tip in the form of an inverted cone, without appendage.

The dorsal edge of the collar (Plate CXXI, fig. 6*a*), which is supported by the first bristle-bundles, forms the commencement of the alar membrane, which passes backward over the anterior bristles to their termination, beyond which its thin edge projects ventrally as a flap of a bluntly conical outline. In the preparations, as a rule, the anterior edges of the alar membrane approach each other, whilst the posterior margins, as they trend to the ventral surface, are wide apart. The bristle-tufts stand clear of the membrane on each side, and the free ventral flap is ample. The dorsal surface in this region is somewhat flattened, whilst the ventral is slightly convex and marked by a median groove. In the second region the dorsum of the body is slightly convex throughout, and the ventral surface is but little flattened, though marked by a median groove which runs to the tapered tail, with the

bilobed anus at its extremity. There are about seventy segments in the posterior region.

The general colour of the body is reddish orange, the alar membrane anteriorly being paler. The lower tier of the operculum is pinkish in lateral view.

The first setigerous process is separated by a considerable interval from the second, and is directed upward and forward. It has two kinds of pale golden bristles, viz., a series similar to those of *Serpula vermicularis* (Plate CXXX, fig. 10), with stout, slightly curved, shafts, which gently dilate from the base upward to the shoulder, beneath which in the larger is a slight convexity posteriorly, and another at the shoulder anteriorly. The shaft is striated and has a central differentiation or axis, which trends distally to the long tapering process with a finely serrated edge. Superiorly the shoulder abruptly ends in two short spurs (horns of some) with rounded tips. Three of these bristles toward the upper edge of the tuft are larger and longer than the others, and probably have special functions. The second kind of bristle is a simple slender form (Plate CXXX, fig. 9) with simple tapering, minutely serrated tip, often slightly curved, and they are distributed over the whole breadth of the fascicle, a few shorter forms being visible at the lower edge. Six pairs of bristle-tufts follow, their direction being obliquely upward and backward. These are simple, rather strong, slightly curved and tapering bristles with narrow serrated wings (Plate CXXX, figs. 9 and 9'), and in ordinary specimens the tips seem to have suffered from friction.

The posterior region of the body has no bristles anteriorly, but toward the tail from nine to eleven pairs of long, slender tapering capillary bristles appear, decreasing in length from the first to the last. They are usually in pairs, and are nearly straight, only a trace of a curve being observable in their slender tips, which appear to be minutely serrated. Moreover, at the base of these are four or five brush-shaped forms with a cylindrical shaft and funnel-shaped tip with short spikes (Plate CXXX, fig. 9a).

The anterior rows of hooks are long, and pass ventrally from the bristle-bundles. Each hook (Plate CXXX, fig. 9b) is somewhat polygonal in outline, the anterior edge having six strong teeth (occasionally only five, in which case they are somewhat larger) above the main fang, whilst below it a narrow gulf and a prominent prow give a character to the hook. The posterior outline forms one of the oblique sides of the polygon, the inferior outline being nearly straight. Slight striæ cross the body of the hook obliquely. The number of hooks in these long rows is great, and the pigment-line indicating them remains after removal of the cuticle and hooks.

The posterior hooks (Plate CXXX, fig. 9c) have the posterior outline considerably lengthened so as to alter the character of the hook, and give it a resemblance to that often seen in the Ampharetidæ and Terebellidæ. They have four teeth above the chief fang, which is proportionally larger than in front, and the basal outline is slightly convex. Oblique striæ are also present on the body of the hook. The ligament, as in the anterior hooks, is attached to the angle between the posterior outline and the base.

Reproduction.—De St. Joseph (1898) describes the eggs as reddish, and the sperms as minute with a refringent head. Dalyell (1853) figures reddish ova on the plate with the tubes and annelids, but no reference is made to them (fig. 7). A young example from Lochmaddy was developed on the blade of a tangle. At Naples Lo Bianco (1909) found that two species of this genus, viz., *Hydroides pectinata*, Phil., and *H. uncinata*, Phil., were mature—the former

from June to September, the latter from April to August. The former is probably identical with the British species.

The tubes (Plate CXXI, fig. 6*d*, and Plate CXXXIII, fig. 1*a*) are very common in deep water on stones, shells, zoophytes, Polyzoa and laminarian roots, and are characterised by their smooth white coils marked only by circular lines of growth, which give them a barred appearance. Longitudinal ridges are rare, and when present are slightly developed. Sometimes, as Montagu observed, the small end of the tube is turned contrary to the rest of the shell, and the aperture almost invariably turns in the reversed direction. On certain grounds the growth of this species is remarkable. Thus the right valve of *Cyprina islandica*, which appears to have been fixed in the erect position on the bottom, bristles internally with multitudes of the tubes, which project from the surface like coarse calcareous hairs, whilst externally more than half the shell is covered, but the ends of the tubes do not stand erect as on the inner surface. Philippi (1844), unaware of previous notices, termed this form *Eupomatus pectinatus*. He found one example with two perfectly similar opercula.

Mörch (1861) places under his variety *a*, *S. vermicularis*, *S. angulata*, *Vermilia intricata*, *Serpula Mülleri*, and *S. spirographis*; whilst under variety *b* are *S. reversa*, *S. contorta*, etc. He considers the *Morchia turbinata* of Philippi as a fossil variety.

The *Eupomatus trypanon* of Claparède (1870) seems to be only a variety of this form. The Swiss author prefers to retain the title of *Eupomatus*, Philippi, for he is of opinion that *Hydroides*, Gunnerus (1768), was not considered by its author as distinct from *Serpula*—with which it was synonymous.

Lo Bianco (1893) describes three species of *Hydroides* from Naples, viz., *H. uncinata*, Phil., *H. pectinata*, Phil., and *H. lunulifera*, Clap., but in all probability a single form is represented, viz., his *H. pectinata* (= *H. norvegica*).

Hargitt¹ (1910) describes the spawning of a colony of *Hydroides dianthus* at Woods Hole in July, in which eggs and sperms were discharged simultaneously over a period of about forty minutes, each annelid sending out a jet of sperms or ova, the former being diffused through the water, the latter soon settling on the bottom.

Orton² (1914) observes that this species grows to nearly full size in about four months, and a specimen of this age shed ripe eggs.

One observer called this form *Serpula solitaria*, Mihi, Scarborough, on Corallines.

A drift bottle containing a Fishery Board notice had single examples or small groups of this species here and there on its surface, and the majority were gently coiled, some forming sinuous lines—perhaps with a curve at the tapered end. A few, however, were closely coiled. They were accompanied by *Pomatocerus triqueter*, *Membranipora*, *Tubulipora*, by the reptant form of *Eucratea chelata*, young *Capuli*, a few *Balani*, and patches of *Alycyonium digitatum* and *Tubularia*.

Genus CLXXIX.—SERPULA, *Linnaeus*, 1767.

Collar with a gap dorsally, and extending as a deep frilled lamella laterally to form a continuous border ventrally. Bristles bayonet-shaped, with spurs at the base of the

¹ 'Amer. Nat.,' xliv, pp. 376–8.

² 'Journ. M.B.A.,' vol. x, p. 316.

blade. Branchiæ of moderate length, the filaments tapering from base to apex, where there is a long process. Pinnæ of moderate length. Circular membrane at base. Operculum a fluted vase of 50—106 crenations and supported on a funnel-shaped pedicle—broad end upward. Rudimentary operculum a short clavate process. Body broad in front and gradually tapered to the anus. Ventral median groove from a triangular area in front to the tip of the tail. Anterior region of seven bristled segments, with short thoracic membrane. Posterior region of many segments (70—140). First pair of bristle-tufts has long setigerous processes, with two kinds of bristles, viz., a strong series with a shoulder, two spurs, and a terminal whip, and a more slender series with curved, slightly tapered and serrated tips. The succeeding bristles of the region have tapering tips, with narrow serrated wings. Posterior bristles very long and slender, with a minutely serrated, hair-like point. Asymmetrical brush-shaped bristles accompany them. Anterior hooks avicular, with four teeth above the main fang and a prominent prow beneath it. Posterior hooks smaller, and with five teeth above the chief fang. Tube has a trumpet-shaped aperture, with rings of growth, spirally coiled posteriorly; free or fixed.

Philippi was inclined to restrict the genus *Serpula* to those having the operculum horny and in the form of a shallow funnel-shaped plate, supported on a subconical fleshy petiole; but such a character, apart from the structure of the soft parts, bristles and hooks, is not reliable.

1. SERPULA VERMICULARIS, *Linnaeus (Ellis)*, 1755. Plate CXVI, figs. 4 and 4a—tubes; Plate CXXI, figs. 7 and 7a—operculum and branchia; Plate CXXX, figs. 10—10c—bristles; Plate CXXXI, figs. 3 and 3a—hooks.

Specific Characters.—Collar with a considerable gap dorsally, passing as a deep frilled lamella laterally and continuous from side to side ventrally. Branchiæ of moderate length, with thick cuticle and of a bright red hue near the tip, the filaments diminishing from base to apex and ending in a long tapering process. Pinnæ of moderate length, longest about one-third from the tip, tapered from base to apex. Rudimentary operculum a short clavate process. Complete operculum a fluted vase of fifty to one hundred crenations supported on a pedicle, which increases in size in its progress upward. Body reddish or orange, broad in front and gradually tapered to the tail, with the anus at the tip; flattened both dorsally and ventrally, and marked ventrally by a median groove, which runs from a triangular area in front to the tip of the tail. Anterior region short, of seven bristled segments, and the fused peristomial segment, with an alar membrane. Posterior region of the body has 70—140 segments.

The first pair of bristle-tufts has long setigerous processes, and generally resembles that of *Hydroides norvegica* in structure, viz., with two kinds of bristles, a strong series with a shoulder, two spurs and a terminal whip, and a more slender series with slightly curved, tapered and serrated tips, but the tufts are separated by a greater interval from the next, and they are nearer the mid-dorsal line. The rest of the anterior bristles are simple, with tapering tips and narrow, serrated wings. The posterior bristles are extremely long and slender, with a minutely serrated, hair-like point. Asymmetrical brush-shaped bristles accompany them. Anterior hooks in long rows, avicular, with four teeth above the main

fang, a sinus, and a prominent prow beneath it; posterior outline slightly concave, inferior outline convex. Posterior hooks smaller, but with five teeth above the chief fang. Tube 3—4 inches long, having a trumpet-shaped aperture, pinkish or greenish in colour, with rings of growth, and occasionally a rough ridge; spirally coiled posteriorly. Free or fixed.

The body-wall anteriorly in *Serpula vermicularis* (Fig. 167) has externally a somewhat firm hypoderm, and ventrally it is more vascular. The circular muscular coat extends all round and has special developments at the feet. The dorsal longitudinal muscles form massive kidney-shaped lobes in transverse section, separated in the mid-dorsal line, but extending from the dorsal almost to the ventral edge, and are proportionally larger than in *Protula*. The ventral longitudinal muscles, again, are smaller, widely separated, and have the nerve-cords with the large neural canal at the inner border. Between the latter

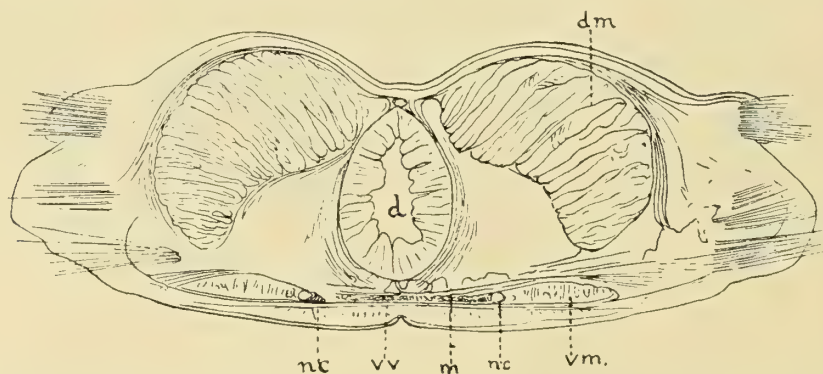


FIG. 167.—Transverse section of the body-wall of *Serpula vermicularis*, in the anterior region. *d.*, alimentary canal; *dm.*, dorsal longitudinal muscles; *m.*, special ventral longitudinal muscular layer; *nc.*, nerve cord; *nc.* (right), neural canal; *vm.*, ventral longitudinal muscles; *vv.*, ventral blood-vessel.

stretches a thin but continuous layer of longitudinal fibres, having the circular coat externally and the ventral blood-vessel internally. The dorsal fold (external) at the foot is hollow in the centre. A peri-intestinal sinus envelops the alimentary canal throughout the greater part of its length. The thoracic glands are similar to those in the Sabellidæ. Little change occurs in the structure of the body-wall posteriorly. In this region the nerve-cords are in contrast with the large neural canals, since in section the nerve-tissue proper is barely a fourth the area of the neural canal. It thus appears to be misleading to term the canal a "giant fibre." The remarkable intermingling of the muscular fibres which course from the dorsum by the side of the alimentary canal and pass below the ventral blood-vessel to cross with fibres from the opposite side and reach the circular coat is one of the features of the region.

SYNONYMS.

1555. *Vermes in tubulis delitescentes*, Rondeletius. Univ. Aquat. Hist. pars altera, p. 110, with fig.
 1606. Tubuli alii parui in quibus etiam vermes delitescunt, Aldrovandi. De reliq. Anim. exang., p. 562, with fig.
 1746. *Serpula vermicularis*, Linnæus. Fauna Suecica, p. 280.
 1755. *Tubus* „ Ellis. Corall., p. 117, pl. xxxviii, fig. 2.
 1758. *Serpula intricata*, Linnæus. Syst. Nat., 10th Edit., p. 787.
 „ „ *contortuplicata*, idem. Ibid., 10th Edit., p. 787.

1758. *Serpula triquetra*, idem. Ibid., 10th Edit., p. 787.
1760. „ „ Baster. Opusc. Subsec., i, ii, p. 79, tab. ix, fig. 3.
1767. „ *vermicularis*, Linnæus. Syst. Nat., 12th Edit., p. 1267.
- „ „ *intricata*, idem. Ibid., xii, p. 1265.
- „ „ *glomerata*, idem. Ibid., xii, p. 1266.
1769. „ *intricata*, Martini. Conch., Tab. iii, fig. 24A.
1775. *Meerpinzel*, idem. Geschichte d. Natur., 2 Th., p. 486, Taf. lv, fig. 7.
1777. *Serpula intricata*, Pennant. Brit. Zool., p. 146, pl. xci, fig. 158 (misplaced).
1788. „ *vermicularis*, Da Costa. Hist. Nat. Test. Brit., p. 18, Tab. ii, fig. 5.
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1801. *Serpula vermicularis*, Donovan. Brit. Shells, pl. xcv (*partim*).
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1811. *Serpula triquetra*, Laskey. Wern. Mem., vol. i, p. 413.
1812. *Amphitrite campanulata*, Pennant. Brit. Zool., vol. iv, p. 91.
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1817. „ „ Stewart. Elements, vol. ii, p. 422.
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- „ „ *contortuplicata*, idem. Ibid., t. v, p. 363.
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1819. „ *vermicularis*, Turton. Conch. Dict., p. 152, with var. B.
- „ „ *tubularia* and *rugosa*, idem. Ibid., p. 154, pl. xxiv, fig. 84.
1820. „ *vermicularis*, Savigny. Syst. Annel., p. 73.
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- „ „ „ Landsborough. Excurs. Arran, p. 31.
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- „ *Vermilia scabra*, idem. Ibid., p. 430.
- „ *Serpula contortuplicata*, idem. Ibid., art. *Serpula*, t. xlviii, p. 553.
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1836. „ „ Templeton. Ibid., ix, p. 233.
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- „ „ *aspera*, idem. Ibid., p. 439, pl. xix, fig. 1.
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- „ *Vermilia infundibulum*, idem. Ibid., p. 159, pl. xiii, fig. 3.
1870. *Serpula crater*, idem. Suppl. Annel. Nap., p. 161, pl. xiii, fig. 2.
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Habitat.—Not uncommon in the coralline region all round the British shores. Berwick Bay (Johnston); Polperro (Laughrin); Falmouth and Exmouth (W. P. Cocks); 60 fathoms 9 miles off Balta, Shetland (J. G. J.); “Knight Errant,” 96 metres off N. Rona. Plymouth (Spence Bate and B. Rowe, Allen, Crawshay); Torquay (Elwes); Firth of Forth (Leslie and Herdman); West Coast of Ireland (Southern).

The Southern examples, *e.g.*, from Falmouth and Exmouth, are often in massive groups of aggregated tubes attached to pectens, oysters, and other bivalves.

Cosmopolitan, ranging almost from pole to pole. At Cape Bojeador (Ehlers); shores of Cantabria (Rioja); Adriatic (Marenzeller); Australia (Johansson); Magellan (Ehlers); Kerguelen (Marion); shores of France (Fauvel, etc.). Extensively distributed in the North Sea and the Atlantic; Mediterranean (Panceri, etc.); Sweden (Malmgren); Adriatic (Grube), and Eastern Mediterranean (Marenzeller); Madeira (Langerhans); Antarctic regions (Scott. Exped., Pixell; German Exped., Ehlers; French Exped., Gravier).

Dorsally the edge of the alar membrane is continuous with the collar on each side—a considerable gap, however, intervening between the points of attachment. The collar then passes on each side as a deep, frilled lamella to the mid-ventral line, where it is continuous with that of the opposite side. The mouth opens between the branchial fans nearer the ventral than the dorsal border; dorsally it has the ciliated upper lip, and ventrally the ciliated lower lip, whilst below is a triangular area.

The branchiæ, the filaments of which are from thirty to thirty-two on each side, form two fans of moderate length, and are tinted of a fine red hue near the tip. Each filament tapers toward the extremity, and ends in a long tapering process (Plate CXXI, fig. 7a). The cuticle is thick, and the longitudinal and circular muscles well developed, but no chordoid skeleton is present. The pinnæ are of moderate length, the longest being about a third from the tip, and they taper from base to apex, and likewise show no chordoid skeleton. Their colour is variable, reddish with white bars, entirely red or white, with darker zones; sometimes the base is red and the rest white. The pinnæ take their hue from the bars of colour of the region to which they are fixed. In very young examples the base is red, and the filaments greenish from the blood.

The opercula spring from the dorsal edge of the branchial fans, that on the one side being short and rudimentary, whilst that on the other forms a finely fluted vase supported on a stalk, which gradually expands as it passes upward to the fluted cup (Plate CXXI, fig. 7), which has from fifty to one hundred or more denticulations. In many cases the functional operculum is on the left, in others on the right. The distal cup is hollowed and comparatively

thin, and the divisional striæ run to the centre, cutting off the hypodermic areas. Moreover, though the surface of the cup appears smooth to the naked eye, it presents under the microscope numerous minute chitinoid papillæ, and if it has been injured, the cicatrix and various irregularities of the divisions are apparent. Occasionally abnormalities, not due to injury, are present.

The *body* is, in the preparations, broad in front, and tapers gradually to the tail, which ends in the anus. It is flattened both dorsally and ventrally anteriorly, indeed more or less so throughout, and marked ventrally by a median groove, which commences behind a triangular area in front and extends to the posterior end. The anterior region consists of seven bristled segments and the fused peristomial segment, and it is proportionally shorter than in *Hydroides*. The alar membrane is broad dorsally, the sides touching in front and separating posteriorly, whilst the ventral lamella is of moderate breadth. The first pair of pale golden bristle-tufts is even more widely separated than in *Hydroides*, arising from prominent setigerous processes a little behind the anterior dorsal angle of the alar membrane and collar. The distance between this and the next tuft is nearly as large as between the second and seventh, and the direction is upward and forward. The bristles closely correspond in structure with those of *Hydroides norvegica*, and their function is probably similar. Each tuft has a series of strong bristles with long, slightly curved shafts, which expand a little at the shoulder, though some also present a slight convexity posteriorly in the same region. Over the anterior edge of the shoulder are two short, conical spurs, whilst the posterior half is extended into a long tapering serrated process (Plate CXXX, fig. 10). As indicated by Fauvel, the region below these spurs is roughened by numerous spikes in young forms. They afterwards completely disappear. Interspersed with these are the long, simple tapering curved bristles, with minutely serrated edges as in *Hydroides*. The other bristles of the region spring from shorter setigerous processes, have nearly straight shafts and slightly curved tapering tips, with narrow serrated wings (Plate CXXX, fig. 10a). Bristles are absent from a great part of the posterior region, again reappearing in groups toward the tail. They are very long, slender bristles, tapering to a hair-like point which is finely serrated (Plate CXXX, fig. 10b). They are longest at the commencement of the series, diminish posteriorly, and are accompanied by short brush-shaped forms (Plate CXXX, fig. 10c), one outline of the dilated tip being longer than the other. The posterior bristles often have a peculiar fungoid (?) growth, which forms a blackish coating to the shaft or to the tip.

The anterior hooks (Plate CXXXI, fig. 3) are avicular, with four teeth above the main fang, which has a well-marked gulf below and a prominent prow which projects about as far as the point of the chief fang. The crown is comparatively narrow, and the posterior outline is slightly concave, whilst the inferior edge is convex, with a slight incurvation posteriorly. The body of the hook is striated.

The posterior hooks (Plate CXXXI, fig. 3a) are smaller, have as a rule five teeth above the main fang, the prow is less prominent, the inflection of the posterior outline is nearer the base, and the basal outline has a more distinct inflection posteriorly. Striæ likewise pass from the teeth down the body of the hook. The number of hooks in each row is large. Fauvel gives a total of six to eight teeth in the posterior hooks.

The *tube* (Plate CXVI, figs. 4 and 4a), either fixed or free, is of a rosy or greenish colour,

and measures 3 or 4 inches in length, with a smoothly rounded and dilated trumpet-like aperture, various lines of growth, and occasionally with a keel more or less rough. Anteriorly it is straight or with a wide curve, but posteriorly is often coiled in a spiral manner. It is attached to shells, masses of *Cellepora*, to rocks, stones or vases thrown into the sea, and is generally solitary, though masses of the tubes occasionally occur both in the north and west of Scotland. When on the inner surface of the lower (flat) valve of a large oyster the tubes are nearly parallel. In some the prolongation of the tube takes place from the narrower (inner) edge of the trumpet, and thus four or five prominent rings may be formed anteriorly. Fauvel describes seven longitudinal ridges in the typical form of tube, of which the median dorsal is the most conspicuous, and Chamberlin mentions that those from British Columbia had a tinge of green.

Reproduction.—Ripe specimens of *Serpula vermicularis* not more than about ten months old yielded an excellent result on fertilising the ova.¹

Aldrovandus (1606), under *De Testaceis*, after the figure of *Sabella penicillus*, represents various tubes of Serpulids on pp. 561 and 562; the middle figure on the latter page probably refers to those of *Serpula vermicularis*, as diagnosed in the work of Rondeletius, with the tails projecting from the ends of the tubes. It may, however, represent tubes of another species, such as *Hydroides*.

Klein² (1731), in his 'Descriptiones Tubulorum Marinorum,' mentions two tubes: "(1) Solen fragilior digitum longus, gracilis, extus rugosus intus lævis aqua repletus, and (2) Solen fragilior interspersa arena, ita tamen ut, extus æque ac intus lævis sit & diaphanus" (p. 7, No. 2, Tab. i, fig. 5). It is difficult to identify these. He describes under Genus I, *Penicilli*, *Penicillum marinum*, Pinceau de Mer. (Tab. i, fig. 1)—a form which appears to be *Serpula vermicularis*. It is followed by *Dentalium*, *Solen*, etc.

Ellis (1756), in his 'Corallines,' gives a good figure of this form, with six thoracic bristles on the left, and five on the right—a reduced number, probably due to his artist or to an abnormal specimen.

In Plate III of Martini's 'Conchology' (1769) is figured (fig. 24a) a mass of coiled tubes of a Serpulid like those of this species.

Guettard (1774) included this and other marine tube-dwellers along with such forms as *Teredo*, but differentiated the inhabitants in each case, and his figure is recognizable. In referring to Klein's forms he found it difficult to determine the species.

In Montagu's MS. (1808) in the Linnean Society the figure of *Infundibula triquetra* more resembles *Serpula vermicularis* than any other species. A figure of *Amphitrite bicirrata* in this volume shows a deeply ribbed *Serpula*, and is exquisitely figured by Miss D'Orville (his niece), but its identity is uncertain.

Dr. Johnston's *Serpula intricata*, as shown in one of his sketches, is an abnormal example of *Hydroides norvegica*, in which the distal crown has lost its processes and appears like a second grooved inverted cone or cup-like structure.

Philippi (1844) severely criticises De Blainville for his confusing account of this form in his 'Dict. Sc. Nat.,' p. 538, and, further, adds that Cuvier described the operculum as having two or three small points, which it has not.

¹ Orton. 'Journ. M. B. A.,' vol. x, p. 316, 1914.

² P. 7, No. 1.

Delle Chiaje¹ (1841) figures an empty tube of *S. vermicularis* under the title of *Serpula infundibulum*.

The *Serpula Philippi*, Mörch, *S. aspera*, Philippi, as well as *S. infundibulum*, Delle Chiaje, as described by Lo Bianco (1893), seem to be closely related, if not identical, with the present species.

It is possible that the *S. rugosa* of Turton² and the *Vermilia scabra* of Lamarck³ may refer to the young of *S. vermicularis*.

Claparède's (1868) *Serpula crater*⁴ may be included under this species, since the description and figures most closely resemble it. Fauvel, indeed, after an examination of various specimens from the same locality, agrees with this view, and so does Soulier in his revision of the Annelids of Cete.

Langerhans (1880) considers that *S. echinata*, *S. pallida*, and also *S. aspera* of Grube pertain to the present species.

Carus (1885) gives two varieties of this form in the Mediterranean, viz., *S. Philippi*, tube rounded, free, and *S. contortuplicata*, with a triquetrous fixed tube.

Pruvot (1885) shows four cerebral ganglia in *Serpula Philippi* (*S. vermicularis*), but they differ from those of *Sabella penicillus* in so far as the anterior ganglia are large and ovoid, the second pair being smaller and situated posteriorly.

De St. Joseph mentions the var. *S. echinata* from Cannes (similar to what Grube⁵ found), the crenulations on the border of the operculum being less distinct than in the ordinary form. The same author (1894) points out that in the dorsal region of the branchia in section are two transparent glandular pouches in the form of elongated sacs and separated by brown granules. In reality they are two trenches or grooves with their muciparous cells, which resemble cartilage when viewed *in situ* as a transparent object. He observes that Marenzeller confounds this form with *S. Philippi*, Mörch, and Langerhans confuses it with *S. pallida*, Phil., the *S. echinata*, Gm., the *S. aspera*, Phil., and the *S. octocostata*, Quatref. The *S. vermicularis* of O. F. Müller is a *Hydroides*, whilst that of Cuvier is a *Pomatocerus*.

Rioja's (1917) *Serpula Lo Bianci*, n. sp., needs further investigation, and appears to be only a variety, and the same may be said of the *Serpula concharum* of Langerhans.

Genus CLXXX.—POMATOCERUS, *Philippi*, 1844.

The dorsal part of the cephalic collar forms a large free lamella, continuous with the broad ventral part, which is often reflected and joins the alar membrane of the front. Branchiæ in two lateral fans, the filaments ending in subulate processes of some length. Pinnæ comparatively short. Operculum springs from the dorsal edge of the left fan, a flattened cushion, with an ear-like process at each side, bearing the calcareous tip, which may have

¹ 'Descrizione,' pl. lxxi, fig. 40.

² 'Conch. Dict.'

³ Lamarck. An. s. Vert., v, p. 362.

⁴ 'Annél. Neap. Suppl.,' p. 161, pl. xiii, fig. 2.

⁵ 'Jahresb. Schles. Gesellsch.,' 1861, Breslau, 1862, p. 62.

spines. Body wide in front, and with rather a broad tail. A median groove ventrally. Anterior region of six bristled segments; posterior of many segments. Anterior bristles capillary with tapered tips and narrow wings. Posterior bristles with slender shafts, which dilate into a broad shoulder with a curved and spinous edge and a terminal whip on one side. Anterior hooks triangular, with eight teeth above the probe-like modification of the main fang. Posterior hooks with seven teeth above the modified fang. Tube massive, white, keeled and fixed to rocks, stones and shells. It is looped and coiled in various ways.

Philippi (1844) gave the following characters:—Operculum calcareous, hemispherical, with hollow appendages.

1. POMATOCERUS TRIQUETER, *L.*, 1761. Plate CXVII, figs. 1 and 1*b*—body and tubes; Plate CXXII, figs. 2 and 2*a*—branchia and operculum; Plate CXXXI, figs. 7—7*d*—bristles and hooks.

Specific Characters.—The dorsal part of the collar forms a large, free lamella continuous with the broad ventral part, which is often reflected, and joins the alar membrane of the anterior region. It is dull yellow or brown externally at the branchiæ, bluish internally. The branchiæ are somewhat short, and are grouped in two lateral fans of thirteen to eighteen filaments, which, tapering, end in a subulate process of some length. The pinnæ are short and taper slightly from base to apex. A pure white band runs round the base of the branchiæ, bordered by a band of red at each side. The base is madder-brown or violet. The filaments are barred alternately with white and red. The operculum springs from the dorsal edge of the left fan by a rounded stem, enlarges and flattens out as it goes upward and dilates into a flat cushion for the calcareous operculum, which is prettily marked with white, an ear-like process jutting out at its base on each side. Calcareous operculum may be conical, tuberculated, saucer-shaped, bifid or trifid. Body broad in front and with the alar membrane marking the first region, tapering to the rather broad tail; rounded dorsally, flattened ventrally on each side of the median groove; six bristled segments in front, besides the collar-bristles; many segments posteriorly. Dorsum anteriorly pale brown or purplish brown; ventral surface and posterior region dull yellow with pink laterally. Anterior bristles have straight shafts, with a slight bend near the tapering tip, which has narrow wings. Posterior bristles with slender shafts narrowed distally; then dilated into a broad shoulder, with a curved, spinous edge and a terminal whip on one side. Anterior hooks triangular, with eight teeth above the probe-like modification of the main fang; posterior hooks with seven teeth above the modified fang. Tube massive, white, keeled, and with a sharp spine in front; fixed to rocks, stones, shells, etc.

SYNONYMS.

1727. Calcareous tube on shell of crab, Frankenau. Act. Acad. Caes. Leop., vol. i, p. 315, Taf. x, fig. 1.
 1747. *Dentalium*, Linnæus. Westgotha Resa, p. 170 (paa Krabber).

1755. *Serpula vermicularis*, Ellis. Corall., Tab. xxxviii, fig. 2.
 1758. „ *triquetra*, Linnæus. 10th Edit., Syst. Nat., p. 787.
 1760. *Iterum animalculorum ejusdem licet generis*, Baster. Opusc. Sub., ii, pl. ix, fig. 2, A—C.
 1761. *Serpula triquetra*, Linnæus. Fauna Suecica, p. 535.
 1767. „ *contortuplicata*, Linnæus. Syst. Nat., ed. xii, p. 1266.
 1768. „ *triqueter*, Gunnerus. Norske Vid.-Selsk. Skrift., p. 54, Tab. iii, fig. 14.
 1769. „ *triquetra*, Martini. Conch., vol. i, tab. iii, fig. 25.
 1770. *Dentalium testa flexuosa triquetra, antice acuminata*, Ström. Skrift. Kjöbenh. Selsk., 10 Diel, p. 17, Tab. vi, figs. 1—5.
 1776. *Serpula porrecta* and *triquetra*, O. F. Müller. Prod. Zool. Dan., p. 236, No. 2860 and No. 2856.
 1777. „ *triquetra*, Pennant. Brit. Zool., p. 146 (No. 156).
 „ *Vermilia* „ idem. Ibid., No. 158, pl. xci, fig. 157 (fig. misplaced).
 1778. *Serpula angulata*, Da Costa. Elem. Conch., p. 20, Tab. ii, fig. 9.
 1780. „ *triquetra*, O. Fabricus. Fauna Grœnland, p. 379.
 1789. ? *Serpula vermicularis* (*partim*), O. F. Müller. Zool. Danica, t. iii, p. 9, pl. lxxxvi, fig. 8.
 1801. *Serpula vermicularis*, Donovan. Brit. Shells, vol. iii, Tab. xcv.
 1803. „ *triquetra*, Montagu. Test. Brit., ii, p. 511.
 1804-6. *Vermilia* „ Sowerby. Miscell., tab. xxxi.
 1806. *Serpula* „ Turton's Linn., p. 604.
 1807. „ „ and *tubularia*, Turton. Brit. Fauna, p. 202.
 „ „ *tubularia*, Maton and Rackett. Linn. Trans., viii, p. 244.
 1808. „ „ Montagu. Suppl., p. 156.
 1817. „ „ Stewart. Elements, vol. ii, p. 422.
 „ „ „ Dillwyn. Cat. Rec. Shells, p. 1073.
 1818. *Vermilia* „ Lamarck. Anim. s. Vert., t. v, p. 369.
 „ „ *scabra*, idem. Ibid., p. 370.
 1819. *Patella tricornis*, Turton. Conch. Dict., p. 139.
 1820-24. *Vermilia triquetra*, Sowerby. Gen. Shells, fig. 2 c.
 1825. *Vermilia triquetra*, Fleming. Edin. Philos. Journ., xii, p. 242 (with bifid style).
 1826. „ „ Risso. Hist. Europ. Merid., t. iv, p. 407.
 1827. „ „ Brown. Illust. Conch., ii, Tab. ii, fig. 1.
 „ „ „ and *perversa*, idem. Ibid., ii, Tab. ii, fig. 7.
 1828. „ *triquetra*, Blainville. Dict. Sc. Nat., t. lvii, p. 430, pl. i, fig. 3.
 1829. *Serpula* „ Hoffman. Berlin Magaz., p. 150, with fig. annel. (*fide auct.*).
 „ „ *triquetroides*, Delle Chiaje. Memorie, t. iv, p. 208, Tav. lxvii, figs. 15 and 16.
 1830. *Vermilia triquetra*, Fleming. Edin. Encyclop., vii, p. 67.
 1833-45. *Serpula vermicularis*, Cuvier. Règne Anim., p. 191.
 1834. *Serpula triquetra*, Berkeley. Loud. Mag. Nat. Hist., vii, p. 421, and viii, p. 421.
 1835. „ *tubularis*, Harway and Glossop. Proc. Zool. Soc., p. 128.
 1836. *Vermilia triquetra*, Templeton. Mag. Zool. and Bot., ix, p. 233.
 1841. *Serpula triquetroides*, Delle Chiaje. Descriz., t. iii, p. 71, t. v, p. 94.
 1843-53. *Vermilia triquetra*, Payraudeau. Cat. Annel. Moll. Corse, p. 22.
 1844. *Serpula triquetra*, Ersted. Nat. Tids., ser. 2, i, p. 414.
 „ „ „ idem. Region. Mar., p. 78.
 „ „ „ Philippi. Arch. f. Naturges., pp. 190, 199, fig. P.
 „ *Pomatoceros tricusps* and *Vermilia triquetra*, idem. Ibid., p. 192.
 „ *Vermilia elongata*, idem. Ibid., p. 193, pl. vi, fig. 1.
 „ „ *triquetra*, var *serrulata*, Thorpe. Marine Conchol., p. vii, xxi, pl. xiv, fig. 53.

1844. *Serpula placentula*, Bean. Suppl. Thorpe, p. 265.
 „ *Pomatocerus tricuspis*, Philippi. Arch. f. Naturges., 10th Jahrg., p. 194, pl. vi.
1845. *Serpula triquetra*, Ersted. Dyr. ved Dröbak, p. 17.
1849. *Pomatoceros tricuspis*, Leuckart. Zur. Kennt. d. Fauna von Island, Arch. f. Naturges., Jg. xv, p. 189, Taf. iii, fig. 9.
1850. *Vermilia triquetra*, De Quatrefages. Ann. Sc. nat., 3^e sér., t. xiv, p. 373.
1851. „ „ Maitland. Fauna Belg., p. 208.
 „ *Serpula* „ Grube. Fam. Annel., p. 92.
 „ „ „ Sars (Reise, 1849). Nyt Mag., Bd. vi, p. 204.
 „ *Spirorbis porrecta*, idem. Ibid., Bd. vi, p. 205.
1853. *Pomatocerus tricuspis*, Phil., idem. Ibid., Bd. vii, p. 382. (Adriatic Fauna.)
 „ *Eupomatus vermicularis*, Müller, idem. Ibid., Bd. vii, p. 382.
1855. *Vermilia tricuspis*, Morris. Brit. Foss., p. 67.
1859. *Serpula triquetra*, Danielssen (Reise, 1858). Nyt Mag., p. 124.
 „ „ „ idem. Kgl. Norske Vid.-Selsk. Skrift. 4^{de} Bd., p. 124.
 „ ? „ *porrecta*, idem. Ibid., 4^{de} Bd., p. 125.
1861. „ *triquetra*, idem. (Reise, 1857). Nyt Mag., xi, p. 56.
- 1861-63. *Pomatoceros triqueter*, Mörch. Naturh. Tidsskr. Copenhagen, 3 ser., i, p. 408.
1862. „ *tricuspis*, Grube. Jahresb. Schles. Gesells. für 1861, Breslau, p. 66.
1863. *Serpula vermicularis*, Mörch. Naturh. Tidsskr. Copenhagen, 3 ser., p. 390.
 „ *Vermilia dinema*, idem. Ibid., 3 ser., p. 388.
1864. *Serpula triquetra*, Grube. Insel Lussin, p. 92.
1865. „ *conica*, Johnston. Cat. Worms Brit. Mus., pp. 271, 347.
 „ „ *armata*, idem. Ibid., pp. 272, 347.
 „ *Vermilia lamarckii*, De Quatrefages. Annel., t. ii, p. 513, pl. xii, figs. 19-23.
 „ „ *socialis*, idem. Ibid., p. 516, pl. xv, figs. 14-17.
 „ „ *conigera*, idem. Ibid., p. 521, pl. xv, fig. 24 c, and pl. xx, fig. 9.
 „ „ *trifida*, idem. Ibid., p. 528, pl. xv, figs. 24 d and 25.
 „ „ *tricuspis*, idem. Ibid., p. 530.
1867. *Serpula conica* and *armata*, Parfitt. Cat. Annel. Devon, p. 35.
 „ *Pomatoceros triqueter*, Malmgren. Annul. Polych., p. 121.
 „ *Vermilia porrecta*, idem. Ibid., p. 120.
1868. *Pomatoceros triquetroides*, Claparède. Annel. Nap., p. 442, pl. xx, fig. 3.
- 1868-69. „ *tricuspis*, Grube. Mitt. St. Vaast, etc., p. 38.
1872. *Pomatoceros triqueter*, Malm. Annel. Göteb., p. 103.
1873. *Serpula tricuspis*, Kupffer. Jahresb. Komm. deut., p. 152.
1874. *Pomatoceros triqueter*, McIntosh. Ann. Nat. Hist., ser. 4, vol. xiv, p. 206.
1875. „ „ idem. Invert. and Fishes St. Andrews, p. 131.
 „ *Pomatoceros* „ Marion. Rev. Sc. Nat. Marseil., t. iv, p. 311.
 „ „ *triquetroides*, Panceri. Atti. Soc. Ital., vol. xviii, p. 534.
1878. *Pomatoceros triqueter*, Hansen. Arch. Mat. og Nat., Christ., iii, p. 42, Tab. ii, figs. 8-15.
1879. *Pomatoceros* „ Tauber. Annul. Danica, p. 141.
1883. „ „ Levinsen. Vidensk. Meddel. Copenhag., p. 197.
1884. „ „ von Drasche. Beitr. zur Entwick. der Polych., Wien, pp. 1-10, Taf. i and ii (developpt.).
1885. „ „ *triquetroides*, Carus. Fauna Medit., i, p. 277.
1886. *Serpula triquetra*, Harvey Gibson. Proc. Lit. and Philos. Soc. Liverp., vol. xl, p. 159.
1888. *Pomatoceros triqueter*, Cunningham and Ramage. Trans. Roy. Soc. Edinb., vol. xxxiii, p. 673, pl. xlv, fig. 36.

1890. *Pomatoceros triquetroides*, Malaquin. Annél. Boulon., p. 49.
 1891. *Pomatoceros triqueter*, Hornell. Trans. Biol. Soc. L'pool, vol. v, p. 264.
 1893. *Pomatoceros triquetroides*, D. Ch., Lo Bianco. Atti R. Accad. Sc. Nap., vol. v, no. 11, p. 86.
 „ *Pomatoceros triqueter*, Levinsen. "Hauchs." Tog., p. 354.
 1894. *Pomatoceros* „ De St. Joseph. Ann. Sc. nat., 7^e sér., xvii, p. 353, pl. xiii, figs. 393-407.
 „ *Pomatoceros* „ Bidenkap. Christ. vid.-selsk. Forhandl., p. 138.
 1896. „ „ Appellöf. Bergens Mus. Aarb., xiii, p. 12.
 1897. „ „ Michaelson. Polych. deutsch. Meere., p. 188.
 1898. „ „ Lönnberg. Meddel. f. Kongl. Landtbr., St. no. 1, aar. 1898 (*fide auct.*).
 1904. „ „ Journ. M. B. A., vol. vii, p. 232.
 1907. *Pomatoceros* „ Soulier. Acad. Sc. Montpell., p. 138.
 1909. *Pomatoceros* „ Fauvel. Bull. Inst. Oceanogr., No. 142, p. 66.
 „ „ „ Lo Bianco. Mitt. Zool. Stat. Neap., Bd. xix, p. 584.
 „ „ „ Fauvel. Ann. Sc. nat., 9^e sér., t. x, p. 210.
 1910. „ „ Southern. Proc. Roy. Irish Acad., vol. xxviii, p. 242.
 „ „ „ Elwes. Journ. M. B. A., vol. ix, p. 66.
 1911. „ „ Fauvel. Bull. Inst. Oceanogr., No. 194, p. 39.
 „ „ „ Ditlevsen. Danmark-Eksped. Grönl., Bd. v, p. 430.
 „ „ „ Riddell. Proc. Liverp. Biol. Assoc., vol. xxv, p. 65.
 1912. „ „ Crawshay. Journ. M. B. A., vol. ix, p. 347.
 „ „ „ Wollebæk. Skrift. selsk. Krist., Bd. ii, No. 18, p. 114, pl. xlii, figs. 1-6, and pl. xlix.
 1913. „ „ Giard. Œuvres Div., p. 57.
 „ *Pomatoceros* „ Stephenson. Trans. Roy. Soc. Edin., vol. xlix, p. 808.
 1914. „ „ Southern. Proc. Roy. Irish Acad., No. 47, p. 147.
 „ „ „ Fauvel. Campag. Scient. Monaco, Fasc. xlvi, p. 347.
 1915. *Pomatoceros* „ Allen. Journ. M. B. A., vol. x, p. 644.
 „ *Pomatoceros* „ Southern. Irish Sc. Invest., No. 3, p. 49.
 1920. „ „ Eliason. Polych. Öresund, p. 79.

Habitat.—Abundant on most shores of the British Islands, occurring both between tide-marks on stones and rocks, on shells in the laminarian zone and deeper water beyond, often in company with *Hydroides norvegica*.

Dublin Bay and West Coast of Ireland (Southern); Forth (Cunningham and Ramage); Plymouth (Spence Bate and B. Rowe, Allen, Crawshay); Torquay (Elwes).

It extends to Greenland (Ditlevsen), Iceland (Leuckart), Finmark (Norman), Spain (Rioja), Mediterranean (Delle Chiaje, Grube, Philippi), shores of France (De Quatrefages, De St. Joseph, Fauvel, etc.).

The dorsal part of the collar forms a great free lamella, which, probably by accident, is sometimes separated from the rest of the collar, and its edges are laciniated, though normally it seems to be smooth. The collar continues to the ventral surface as a broad membrane usually thrown into folds in the preparations. De St. Joseph considers the separate parts of the collar dorsally are normal (Plate CXVII, fig. 1).

The branchiæ are somewhat short, and arranged in two lateral fans of thirteen or fourteen to twenty (De St. Joseph) filaments, each of which is tapered from base to apex, where it is terminated by a subulate process of some length (Plate CXXII, fig. 2). The pinnæ

are short, and slightly tapered from base to apex. The branchiæ in young forms are pale, the central part of the middle region reddish, and the posterior part pale cream-colour. A white band of great purity runs round the base of the branchiæ, bordered by a belt of red on each side. The filaments are barred alternately with white and red. Methylated spirit alters the red colour of the branchial plumes to a permanent blue. De St. Joseph found *Trichodina pediculus*, Elw., on the branchiæ at Dinard, which he has made classical to all marine zoologists.

The single operculum (Plate CXXII, fig. 2*a*) springs from the dorsal edge of the left fan by a somewhat rounded stem, enlarges and flattens out as it proceeds upward, and dilates at the summit into a large flat cushion for the support of the calcareous operculum, which is prettily marked with white (shield-like). Just before the last-mentioned dilatation it sends out a process on each side, and occasionally this auricular process is bifid, or quadrifid. The calcareous tip assumes various forms, viz., conical, bluntly tuberculated, saucer-shaped, bifid or very often trifid. On removing the calcareous cap, a tough layer is left on the summit of the cushion with projections corresponding to the form of the cap. The cone is not regular, but has its steepest side placed dorsally. After the action of hydrochloric acid on the operculum a brownish scale of organic tissue with somewhat regular hexagonal reticulations is left. Internally the opercular pedicle has a strong elastic ligament from the summit to the base, surrounded by muscular bundles—chiefly transverse. The thrusting out of the operculum (if such happens) is thus voluntary, the withdrawal and retention more or less involuntary.

The cuticle of the entire opercular apparatus is tough and glistening, faintly marked under the microscope with fine striæ. The colour of the operculum varies, most being pale, the stalk often presenting two specks of brown. Almost every example from Lochmaddy, North Uist, has an operculum with three prongs, the only exception being one here and there with only two prongs, but in all probability a third would by-and-by appear. A variety with a flat operculum from which the three spikes arose was also occasionally met with. The operculum is a favourite site for parasitic growths such as the chambered *Foraminifera*, *Vorticella*, and zoophytes.

In minute structure the body-wall anteriorly shows a thick coat dorsally of long, narrow, hypodermic cells, so that such might be supposed to act as a substitute for the chordoid skeleton of other forms. The projection of the opercular stalk causes asymmetry of the body-wall, and of the incipient dorsal longitudinal muscles, for the muscle of the opercular side considerably increases in size, and this asymmetry continues after the stalk separates. It disappears when the branchial filaments approach separation.

In the thoracic region the dorsal and ventral blood-vessels are of large size, and the *rete* around the alimentary canal is well developed, forming a belt of longitudinal vessels as observed in the section.

When the body-wall assumes a more symmetrical outline, the special, thin, longitudinal muscular bands on each side have disappeared, and the actual longitudinal ventral muscles are formed on the lateral region outside the anterior glandular organ, and its appendix toward the tail. Again, the dorsal longitudinal muscles are connate in the middle line and occupy almost two-thirds of the circumference.¹

¹ Vide further details in 'Ann. Nat. Hist.,' ser. 9, vol. ii, pp. 41—55.

The *body* (Plate CXVII, fig. 1) is widest anteriorly, where the alar membrane further increases the breadth, and tapers gradually to the tail, which ends in a somewhat broad tip, with a papilla at each side. The dorsum anteriorly is pale brown or purplish-brown, whilst the general colour posteriorly is dull yellow with pink lateral regions. It is rounded dorsally, slightly flattened and grooved ventrally. The anterior region consists of six bristled segments¹ and the fused peristomial segment, thus differing from *Serpula* and *Hydroides* in the absence of the conspicuous first pair of bristles on the dorsal edge of the fused collar and alar membrane. The alar membrane passes backward above the bristles, the sides separating as they go to fuse with each other as a broad thin flap on the ventral surface behind the anterior region. Anteriorly it and the collar are yellowish externally and bluish internally, and the same bluish colour appears laterally and posteriorly. The posterior region has sixty to seventy segments. The two papillæ below the anus are rounded distally with a broad stalk proximally, but vary with the movements of the vent in its respiratory functions. All the bristles are directed upward and backward as pale golden flattened tufts, and the structure is the same throughout this region. Each bristle (Plate CXXXI, figs. 7 and 7a) has a translucent and nearly cylindrical shaft, with a slight curvature toward the commencement of the tapering tip, which has two narrow wings so arranged that in certain views the space between them seems to be hollowed out.

The posterior bristles (Plate CXXXI, figs. 7b and 7b') have slender, cylindrical shafts, which diminish and then dilate superiorly as they approach the broad shoulder, the spinous distal edge of which has a concavity trending on one side to a delicately tapered whip. This peculiar tip would seem to combine the functions of the long simple and the brush-shaped bristles of other forms.

The anterior bristles have a proportionally short hold of the tissues—a feature of importance in connection with the habits of the annelid, and whilst they point upward and backward, the posterior are directed transversely or ventrally and slightly forward. In each case the bristles are at the end of the rows of hooks—the anterior at the dorsal end, and the posterior at the ventral end.

The alimentary canal appears to be similar to that of *Sabella*—forming a moniliform duct—wide anteriorly and diminishing posteriorly. It is coated with nucleated cells externally.

The coelomic corpuscles are large and round. De St. Joseph found Protozoa apparently referable to *Anoplophyra*, Stein, in the intestine. A yellowish coiled gland occurs anteriorly—external to the gut and adhering to the body-wall. Its structure is granular.

The anterior hooks (Plate CXXXI, fig. 7c) have the shape of a triangle, the posterior outline (slightly concave) gently curving to the crown and forming the base of the triangle, the sides of which are formed by the anterior outline with its eight teeth and the peculiarly modified main fang, which resembles a blunt probe-like process with a small incurvation beneath, the prow being minute and trending with a slight curve to the inferior outline, which is nearly straight, and the body of the hook is crossed by oblique striæ. The number

¹ De St. Joseph states that there are seven, but six only occur in Britain.

of these hooks in each row is great, and in some they are indicated by a dark line with a dark speck at the ventral end.

The posterior hooks (Plate CXXXI, fig. 7*d*) are smaller, have only seven teeth above the modified main fang, but their shape agrees with that of the anterior hooks. Both these and the anterior hooks are situated near the edges of muscular lamellæ—a provision probably enabling them to fix on the walls of the tube with greater accuracy.

A variety which occurs abundantly at North Uist and is characterised by the sharp spike over the aperture of the tube, and almost invariably a three-pronged operculum, has hooks which deviate from those at St. Andrews, for they form a long triangle and have a larger number of teeth above the modified main fang, viz., eight in the anterior hooks and nine or ten in the posterior. A similar spike over the aperture is met with at St. Andrews.

Habits.—The species has great vitality, surviving in impure water, or living in a small quantity of unchanged sea-water for a week. An example from St. Andrews reached Perth on the 14th February, and lived till it was preserved, on July 3rd, in a jug of sea-water—meanwhile having made a considerable addition to its tube, the new portion being distinguished by its pure white colour. The rapid growth of the tube and the corresponding development of the annelid is sufficiently shown by the presence of well-developed examples on the carapace of the adult *Carcinus mænas*. Orton¹ indeed (1914) found that it grew to nearly full size in four months, and at this age yielded practically 100 *per cent.* of embryos on being artificially fertilized.

Reproduction.—“The abdomen is red in the females, and whitish in the males when sexually mature” (Cunningham and Ramage). McBride² mentions having reared the young of [*Pomatocerus* until the larvæ attained the adult condition and had formed tubes which were attached to the sides of the vessel. Lo Bianco (1909) found those at Naples sexually mature in March and April.

The tube is somewhat triangular in section, with a dorsal keel, and it is firmly fixed to shells, stones, rocks and various structures. At Lochmaddy, North Uist, the tubes of this form are common at low water under stones, and in turning these over the sharp spike above the aperture wounds the hands. Such spikes are less common and less acute at St. Andrews. Montagu observed that one on a glass bottle was unusually spread at the base, as if it was requisite to take a firm hold of so smooth a surface. Oyster shells in Loch Carron (J. G. J.) are often covered by a dense incrustation of this species on both surfaces, and so in the South of England—indeed wherever oysters occur. In the same way empty *Buccini* and other shells are densely coated externally and internally, and masses form on various structures thrown into the sea on favourable ground.

Arnold Watson forwarded tubes collected in Wales in which a calcareous grating had been secreted inside the fractured posterior end. This as well as the secretion of one-eighth of an inch of new tube was done in a fortnight. The accompanying sketch (Fig. 168) by Mr. Watson indicates this interesting feature, which he associates with the physiology of the parts, especially as he noticed a “pumping action of the tail.” The same author has drawn attention to the camerated condition of the tubes in many cases—a condition alluded to by

¹ ‘Journ. M. B. A.’ vol. x, p. 316.

² ‘Nature,’ August 10th, 1911.

Delle Chiaje, and he kindly furnishes two diagrams to illustrate the state of the parts, one, Fig. 169, giving an outline in vertical section, and the other, Fig. 170, showing a sagittal (horizontal) section. Such an arrangement conserves the secretion, whilst it does not diminish the strength of the tube.

FIG. 168.

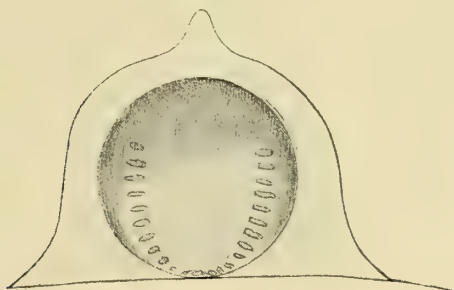
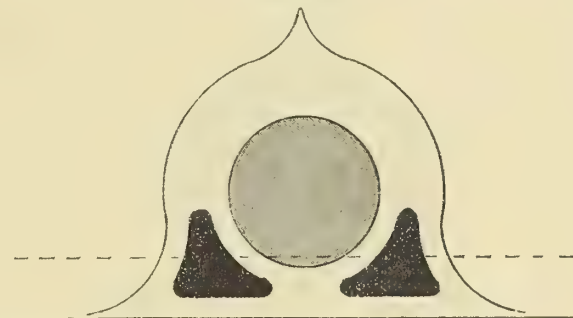
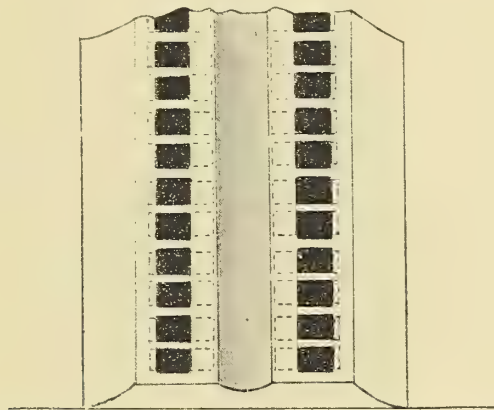


FIG. 169.

FIG. 168.—Diagram of a diaphragm secreted by *Pomatocerus triqueter*. After Arnold Watson.FIG. 169.—Diagrammatic vertical section of a camerated tube of *P. triqueter*. After Arnold Watson.

In Montagu's MS. volume (1808) in the Linnean Society is a drawing of "*Infundibula bicirrata*," a Serpulid with three ridges and two grooves along the slightly bent, not coiled, calcareous tube, and a blunt operculum is present. It is difficult to be certain as to the species, but it has the appearance of *Pomatocerus*.

Philippi (1844) made two species of this form, viz., *P. tricuspis* and *Vermilia triquetra*, the latter having an operculum with two appendages, and supporting a forked process with

FIG. 170.—Diagram of the camerated tube of *P. triqueter* in horizontal section. After Arnold Watson.

obtuse ends. It is possible that Cuvier referred to this species as *S. vermicularis*, since he states that the operculum is armed with two or three points.

De Quatrefages¹ (1850) gave a description of the nervous system of this species, which on the whole resembles that of *Hydroides norvegica*. The cephalic ganglia have smaller branchial trunks.

Dr. Johnston's *Serpula Berkelyi* (or *S. Berkeleyi*), from Berwick Bay, is represented by a tube with a dorsal keel in the British Museum, and the aperture seems to have been broken. A second collection has two specimens partially extracted from tubes attached to a board

¹ 'Ann. Sc. Nat.,' 3^e sér., t. xiv, p. 373.

and registered (66. 1 . 30 . 33) "Falmouth, W. P. Cocks." One has a vase-shaped operculum, smooth all round and slightly hollowed. The stalk has lateral processes. From the shape of the hooks it would appear to be a variety of *Pomatocerus triqueter*. The same author's example of *Serpula Dysteri* in the British Museum is *P. triqueter* with a modified operculum developing two spikes on the top. The specimens came from Berwick Bay and Polperro. Dr. Johnston's *Serpula conica*, which has a conical process developed on the cup-like base, is also *Pomatocerus triqueter*, and the same holds for his *Serpula armata*, with a bifid crown to the operculum, and for *Serpula Dysteri*.

Drasche¹ (1884) described the development of *Pomatocerus triqueter* from the early stages of the segmenting reddish violet eggs to the pelagic post-larval form with three pairs of bristle-bundles, and the appearance of the hooks. In the younger form of three days, the anal sac, the excretory canal and the mesoderm cells were clearly defined.

De St. Joseph (1894) observed that the seven segments of the thorax are constant, and so with the presence of a small bifurcate tongue or process at the base of two of the first dorsal branchiæ.

Genus CLXXXI.—PLACOSTEGUS, *Philippi*, 1844.

Cephalic collar thin but deep, continuous, except at the dorsal hiatus, where it fuses with the alar membrane. Branchiæ of moderate length, with subulate terminal processes. Operculum arising from the dorsal filament of the left fan, with a horny hollow saucer-shaped cap distally. Anterior region of the body has six bristled segments. Anterior bristles simple, with slightly curved, tapering tips and narrow rings. In the posterior bristles the narrow neck expands into a flattened shoulder with the distal edge serrated and a short, tapering whip at one border. Anterior hooks with a long and minutely denticulate anterior edge, terminated inferiorly by a blunt process (representing the main fang). Posterior hooks similar but smaller. Tube fixed, vitreous, translucent, of great hardness, only curved, not coiled; the aperture with a dorsal spike and two infero-lateral spikes.

Philippi (1844) instituted this genus for forms with a calcareous operculum, forming a shallow disc, margin entire, and resembling that of a gastropod. He did not refer in the generic characters to the nature of the tube. In certain respects his account of the operculum of *Eupomatus* would suit *Placostegus* as here interpreted.

1. PLACOSTEGUS TRIDENTATUS, *J. C. Fabricius*, 1799. Plate CXXII, figs. 3 and 3a—operculum and branchia; Plate CXXXI, figs. 8 and 8a—bristle and hook.

Specific Characters.—Collar deep, but thin and translucent, continuous, except at the dorsal hiatus, where it fuses with the alar membrane. Branchiæ of considerable length, filaments little tapered, and ending in short subulate processes. Pinnæ rather short, continued to the base of the terminal process without evident diminution. Operculum springing from the left fan, with a horny, hollow cap of an olive hue.² Body widest anteriorly, tapering to

¹ 'Entwickl. der Polychæten,' Erstes Heft, Wien, 1884.

² Langerhans, after Hansen, states that the first segment has groups of eyes on each side and no bristles, and that the operculum has a slit. In the preparations no eyes are visible.

a flattened tail, rounded dorsally, flattened and grooved ventrally. Anterior region with six bristled segments, the bristles being simple, with slightly curved tapering tips and narrow wings. Posterior bristles in groups of two or three, the shaft narrowed at the neck, then expanding into a flattened shoulder with the distal edge serrated, and a short tapering whip at one border.

Anterior hooks with a long and minutely denticulate anterior edge and a blunt process inferiorly (representing the main fang). Body narrow and translucent. Posterior hooks similar but smaller. Tube fixed, vitreous, of great hardness, only curved, not coiled, and the aperture with a dorsal spike and two infero-lateral spikes.

SYNONYMS.

1761. *Serpula triquetra*, Linnæus. Fauna Suec., ed. 2, p. 535.
 1768. „ „ Gunnerus. Norske Vid.-Selsk. Skrift., iv, p. 53, Tab. ii, fig. 14.
 1776. „ „ Müller. Prodr. Zool. Dan., p. 236, no. 2856.
 1779. „ *tridentata*, J. C. Fabricius. Reise nach Norwegen, p. 385 (*fide auct.*).
 1808. „ *triquetra*, Montagu. Suppl., p. 157.
 1825. „ *serrulata*, Fleming. Edin. Encycl., vii, p. 67, t. cciv, fig. 8.
 „ *Vermilia* „ Idem. Edin. Journ., p. 243.
 1827. ? *Serpula* „ Brown. Illust., pl. ii, fig. 8, edit. 2 ; pl. lviii, fig. 8.
 1836. *Serpula crystallinus*, Scacchi. Catalogo, p. 18.
 1841. „ *triquetroides*, Delle Chiaje. Descriz., vol. v, p. 94, and Memor. iv, p. 208, t. lxxvii, figs. 15 and 16.
 1844. *Placostegus crystallinus*, Philippi. Arch. f. Naturges., 10th Jahrg., p. 192.
 1845. *Serpula serrulata*, Johnston. Index, Ann. Nat. Hist., xvi, p. 454.
 1851. „ *polita*, Sars. Reise 1849, Nyt. Mag., vi, p. 204.
 1854. *Vermilia tricuspidata*, Morris. Brit. Foss., p. 95.
 1859. *Serpula polita*, Danielssen. Reise, 1857, p. 124.
 1861-63. *Placostegus tridentatus*, Mörch. Nat. Tidskr., 3 R., p. 414.
 1864. „ *politus*, Sars. Forh. Vid.-Selsk. Christ., p. 57.
 1867. „ *tridentatus*, Malmgren. Annul. Polych., p. 121.
 1873. „ *crystallinus*, Kupffer. Exped. Ostsee "Pommerania," p. 152.
 1874. „ *tridentatus*, Malm. Annel. Göteborg., p. 103.
 1878. „ „ Hansen. Arch. Math. Naturvid., Tab. iii, figs. 1-7, p. 43.
 1879. „ „ Tauber. Annul. Danica, p. 140.
 1880. „ *tricuspidatus*, Langerhans. Zeitschr. f. wiss. Zool., Bd. xxxiv, p. 121.
 1884. „ *tridentatus*, idem. Ibid., Bd. xl, p. 275, pl. xvi, fig. 39.
 „ „ „ Levinsen. Vidensk. Meddel., p. 198, Tab. ii, fig. 5.
 1889. „ „ Grieg. Bergens Mus. Aarb., p. 9.
 1891. „ „ Appellöf. Ibid., p. 8.
 1893. „ „ Levinsen. "Hauchs" Tog., p. 354.
 „ „ „ Marenzeller. Polych. Grundes, p. 19, Taf. iv, fig. 17.
 „ „ *tricuspidatus*, Sowerb., Lo Bianco. Atti. R. Accad. Sc. Nap., vol. v, no. 11, p. 87.
 1894. „ *tridentatus*, Bidentkap. Christ. Vid.-selsk. Forhandl., p. 139.
 1896. „ „ Appellöf. Berg. Mus. Aarb., xiii, p. 12.
 „ „ *tricuspidatus*, Roule. Camp. "Caudan," p. 463.
 1897. „ „ Michaelsen, Polych. deutsch. Meere, p. 188.

1908. *Platostegus tricuspидatus*, Ehlers. Deut. Tiefsee-Exped., p. 162.
 1909. „ „ Fauvel. Bull. Inst. Oceanogr., No. 142, p. 69.
 1912. „ „ Wollebæk. Skrift. selsk. Krist., Bd. ii, No. 18, p. 117, pl. xlvii, figs. 1—8; pl. li, figs. 2 and 3.
 1914. „ „ Fauvel. Campag. Scient. Monaco, Fasc. xlv, p. 351.
 1917. „ „ Rioja. Anél. Poliq. Cantáb., p. 89.

Habitat.—Dredged twenty-five miles N.N.E. of Unst, Shetland, in 85 fathoms; in 90, 110 and 125 fathoms 50 miles west of Valentia, Ireland (J. G. J.). It is especially abundant in the north and west, such as Lerwick, Aberdeen, the Hebrides, Loch Long (J. G. J.).

Abroad it ranges from Sweden to Spitzbergen, and Finmark (Lovén, Goës, Ljungman, Malmgren and Sars); Norway (Norman, Wollebæk); Finmark (Norman); 300 fathoms off Norway (Sars); Madeira (Langerhans); Azores (Fauvel); Naples, where it is rare and found at 250 metres (Lo Bianco); shores of Cantabria (Rioja).

The collar in this form is so thin as to be diaphanous, but it is deep, and is joined by the alar membrane dorsally on each side of the hiatus, passing thereafter across the ventral surface to the other side. It is usually thrown into various frills, but it presents no notch or break, though it is easily lacerated.

About twenty-eight branchial filaments occur in each fan, and they are of considerable length, little tapered, and ending in a short subulate process. The pinnæ are comparatively short, but they pass to the base of the terminal process without apparent diminution, so that the effect is to widen the tip. No skeletogenous element appears in either filament or pinna, but the cuticle of the former is thick.

The operculum arises by a stout pedicle on the dorsal edge of the left fan (Plate CXXII, fig. 3), which is considerably thicker than a branchial filament. The pedicle is flattened inferiorly, gradually dilates in its upward course, and then enlarges into the clavate operculum, which is truncated and hollowed out, yellowish when seen laterally, somewhat olivaceous on its distal surface. In lateral view the ventral outline of the apparatus is the more convex, the dorsal being nearly straight. In the preparations it is flexible.

The *body* is widest anteriorly, the alar membrane increasing its bulk in this region, then tapers a little to the tail with the anus at the tip. It is rounded dorsally, slightly flattened ventrally, where a median groove runs throughout the posterior region.

Six pairs of bristle-bundles occur in the anterior region as in *Pomatocerus*, and each has three fascicles. The pale golden bristles (Plate CXXXI, fig. 8) are a little narrowed at the insertion, have straight shafts, and slightly curved tapering tips, which end in translucent hair-like points, and with very narrow wings. The posterior bristles are few in number, two or three, as a rule, being in each foot. The shaft is slender and nearly cylindrical, but is narrowed below the distal enlargement, which forms a flattened blade, with an almost transverse spinous distal edge, one angle of which is produced into a short whip or pointed process. It is remarkable how closely such a bristle resembles the brush-shaped forms of the Eunicidæ, of *Hydroides*, *Pomatocerus*, and other groups, and approaches in outline also the paleolæ of the Sabellarians, as well as the broadly winged forms seen in *Lepræa*. It is a modification of the much bolder series seen in the same region of, for instance, *Placostegus actinocerus*, Grube, from Samoa. In this form the shafts of the tail-bristles are brownish and slightly bent, the distal portion narrowing a little before terminating in the broad, boldly

serrated blade, which then tapers to a fine point (Plate CXXXVII, fig. 18). In the British species the distal blade has been reduced to an insignificant size, but the type has been more or less retained. The size of the representatives of the Serpulids in the tropical and sub-tropical waters is as noteworthy as the proportions of their bristles and hooks. Those of our seas in both respects are diminutive.

The anterior hooks (Plate CXXXI, fig. 8a) are in single rows, very numerous and fairly large, but it is difficult from their translucency to define their exact outline. The anterior edge is nearly straight and saw-like from minute denticulations, the last of which (probably corresponding to the main fang) projects outward and downward as a minute blunt process, the body of the hook forming a narrow, flattened and transparent thin plate. The crown is small and rounded, and the whole body of the hook is easily curved under pressure. The posterior hooks do not differ essentially in structure or arrangement though they are smaller.

Reproduction.—An example procured off North Unst by Dr. Gwyn Jeffreys in July had a series of small ova in a hollow on the ventral surface behind the anterior region, so that it would appear to develop its eggs in the tube.

The tube is of great density, slightly translucent or vitreous, and has anteriorly a sharp dorsal spike and two infero-lateral spikes. A serrated keel runs along the mid-dorsal line, and the tube is fixed to shells, stones or other submarine bodies. The inner surface is smooth and vitreous, and the minute teeth along the anterior edge of the hook are of great hardness. Whilst the initial coil is adherent the distal end stands up freely in many cases. When densely grouped on stones the tubes are less rough, and the aperture is smoother, and as they are coiled and interwoven, and their ends often free, a considerable change thus takes place in the facies of the tube. It still retains its median ridge, but in a modified form. The whole aspect of the mass is in contrast with the ordinary condition of the species. Yet here and there at the edges the usual aspect is observed. The examples indicated came from the deeper water off St. Andrews Bay attached to sandstone and accompanied by the tubes of *Sabellaria*.

It is an interesting fact in connection with Arnold Watson's sketches that Delle Chiaje (1822) observed the cameration of the tubes of Serpulids, *e.g.*, in his *Serpula triquetroides*.¹ He shows a section of the tube with the space at each side. Philippi thought that this author's² *Serpula fimbriata* pertained to the present genus.

Philippi (1844) noticed that the branchiæ had two brown bands, and that there were nine on each side. It lives at great depths.

The *Placostegus tricuspidatus* of Langerhans, *S. tricuspidata* of Sowerby, *S. crystallina*, Scacchi, and *Pl. crystallinus*, Philippi, appear to be closely allied, though the branchiæ are fewer (nine to eleven), and on segment 1 is a band of simple eyes on each side.

A single example of a variety procured in Shetland by Dr. Gwyn Jeffreys in 1867 (which, from its size, may be a young form) differs from *Placostegus tridentatus* in the shape of the operculum (Plate CXXXIII, fig. 4), which has the outline of a vase, with a thin yellowish-green projecting rim, a constriction following an enlargement, then tapering below to a stout pedicle which gradually diminishes from above downward, and thus diverges from

¹ 'Memorie,' tav. lxvii, fig. 16.

² Ibid., tav. xlviii, figs. 19 and 20.

that of *Placostegus* from Cape de Gatte, whilst the operculum proper differs in outline from that of *P. tridentatus*. The distal surface of the operculum is horny and concave. The tips of the *branchiæ* (Plate CXXXI, fig. 9a) show a slender terminal process. The deep, thin collar agrees with that of the other forms. Twelve *branchiæ* occur in each of the fans, and the filaments have a thick cuticle and end in a subulate process. The pinnæ are also similar to those in the typical form. In the form of the body no noteworthy difference is observable, but the two anal papillæ form two short cylindrical and conspicuous processes. The anterior bristles (Plate CXXXI, fig. 9) are typical, and simple delicate tapering bristles occur near the tip of the tail as in *Placostegus tridentatus*. No brush-shaped bristles were seen, but they were probably present.

The anterior and posterior hooks lean rather to those of *P. tridentatus*, the modified main fang being prominent (Plate CXXXI, fig. 9b). No tube is present. On the whole such would seem to be a young form of the species.

Another variety of *Placostegus tridentatus* was dredged 6 miles from shore off Cape de Gatte in 60 to 160 fathoms in the "Porcupine" Expedition of 1870 attached to small stones. It is distinguished from the northern type by the longer and more slender tube (Plate CXXXIII, fig. 2), which may be curved here and there but not coiled, and by the presence of three coarsely serrate ridges—a dorsal and two lateral. The three spines at the aperture also differ in character, since they are longer and curved outward.

The thin diaphanous collar seems to have the same arrangement as in *P. tridentatus*, but the *branchiæ* are proportionally longer, and less numerous, viz., eleven to twelve in each fan; the filaments taper a little from base to apex, where a longer terminal subulate process than in the northern type occurs. The pinnæ, however, continue long to its base. The opercular stalk is slender, and remains nearly of the same diameter to the base of the vase-shaped operculum (Plate CXXXI, fig. 11), which, though smaller, is more elegant in shape than in the ordinary form. The truncated distal end is hollow and horny, the rim only being yellowish.

The *body* is long and narrow, with six bristled segments anteriorly, and numerous posterior segments, which are flattened toward the tail, and end in an anus with a distinct and rounded papilla at each side. The six setigerous processes anteriorly have tufts of the same kind, viz., bristles with straight shafts, very slightly bent tips with narrow wings—in which respects they do not materially differ from those of *P. tridentatus*. Posteriorly bristles seemed to be absent until near the tip of the tail, where each segment has a single, long, slender tapering bristle or two. The brush-like bristles, however, occur toward the posterior end—in front of the simple forms. Each has a slender, straight stem, which dilates distally into the flattened spinous tip—one side of which has a minute whip or pointed process, the tip being thus asymmetrical. The anterior hooks appear to be proportionally smaller and broader than in the northern form, and the modified main fang is indistinct. In both the serrations of the anterior edge resemble transverse grooves of a file, but they are perhaps broader and more distinct in the present form. The posterior hooks are slightly less, but agree in structure with the foregoing. The tube is small, elongated, tapered posteriorly, and fixed to small pebbles. The dorsal and two lateral spinous ridges are diagnostic when compared with the tube of the northern form, for the spinous processes on each are isolated and prominent, as well as occasionally curved, as are also the three anterior spines. Moreover, the entire

tube is more transparent than in the ordinary *P. tridentatus*, and the spines especially so. It represents, however, only a variety of *P. tridentatus*, J. C. Fabricius.

Genus CLXXXII.—APOMATUS.

Cephalic collar narrower, but thicker than in *Placostegus*. It fuses with the alar membrane and passes ventrally as a continuous fold. Branchiæ rather soft and thick, of moderate length; often coiled and doubled; seven filaments on each side, with short terminal processes, one on the right bearing at its blunt extremity a short pedicle for the soft globular operculum. Anterior region of seven bristled segments, with a broad alar membrane. Ventral surface marked by a median groove from end to end. Anterior bristles have finely tapered tips and distinct wings. Posterior bristles confined to the caudal region, and they have short shafts, and broad, sickle-shaped, serrated and striated terminal blades. Anterior hooks avicular, with a rounded crown, a long and minutely serrated anterior edge, with a modified fang inferiorly, a gulf beneath it, and a rounded prow. Posterior outline indented. Tube more or less curved or coiled, a rounded aperture, with a flat ridge between two slight grooves running dorsally from end to end.

Philippi (1844), who constituted the genus, gave it no operculum, the other character being the continuation of the lateral (alar) membrane half the length of the body, and equally broad. He, indeed, was in doubt about the species *Apomatus ampulliferus*, having only seen a single specimen, which he would have regarded as an abnormality if Scacchi had not observed the fresh animal.

De St. Joseph (1894) observes that this genus is transitional between *Protula* and *Filograna*. Like *Protula*, it has feeble branchial filaments, ordinary winged bristles on the first segment, hooks with a long terminal process not hollowed beneath, a long white dorsal keel (carène) to the end of the body. But it approaches *Filograna* in size, by its operculum at the tips of one or two branchiæ, which conserve their barbules, and by the naked anterior region of the abdomen. The abdominal bristles (“*en faucille*”) are like those of *Protula*; they are geniculated and serrated as in *Filograna* (*A. ampulliferus*). Yet it belongs to neither *Filograna* nor *Protula*—since he had not found the thoracic brush-like bristles (*en faucille*) in either. He thought the globular operculum a secondary character. Marenzeller again separates the genera *Apomatus* and *Protula* for other reasons, namely, the appearance of the hooks on the second segment in *Apomatus*, whereas in *Protula* they appear in the third segment, and the thoracic and abdominal bristles approach each other in structure. De St. Joseph, however, found hooks on the second segment in *Protula tubularia*, and so did Sars in *P. borealis*. He concludes by observing that *Protula* has not the thoracic bristles of *Apomatus* and no operculum.

1. APOMATUS AMPULLIFERUS, *Philippi*, 1844. Plate CXXXII, figs. 2—2c—bristles, operculum and branchia; Plate CXXXVII, fig. 19—hook.

Specific Characters.—Collar less developed than in *Placostegus*, but, though narrower, it is thicker and follows a similar arrangement, as, starting from the dorsal edge of the fused

collar and alar membrane, it passes as a continuous fold from side to side. Branchiæ reddish, rather soft and thick, of moderate length, often coiled and doubled; seven filaments on each side, one on the right having at its blunt extremity a short pedicle for the soft, globular operculum, which often shows branching tubules inside it. Pinnæ also rather soft, of moderate length and continued to the end of the filament, which has a short terminal process. Ornamented with purple spots (Carus). Body rather stout, widest anteriorly, and it tapers only a little to the flattened tail. Anterior region of seven bristled segments, and with a broad alar membrane over the bristles. Dorsally is a long conical elevation, with the apex forward, the surface posteriorly being convex, whilst the ventral surface is little flattened, but grooved in the median line from end to end. Anterior bristles of two kinds, directed upward and backward, and forming broad pencils of simple bristles, with straight shafts, a curvature backward at the commencement of the finely tapered tip, which has either a broad or a narrow wing. First bristles dorsal in position, and are directed forward and inward, agreeing in structure with those behind, viz. with curved tips, and broad or narrow wings. Posterior bristles confined to the caudal region, and they have rather short shafts and broad sickle-shaped serrated and striated terminal blades. Those next the tail have long slender tips, less curved. Anterior hooks, which commence on the third setigerous segment, avicular, with a rounded crown, a long and minutely serrated anterior edge, ending inferiorly in a modified (blunt) main fang, with a gulf beneath and a rounded prow. The posterior outline has a deep indentation and the body of the hook is striated. Tube white, more or less curved or coiled, with a smoothly rounded aperture, whilst dorsally is a flat ridge between two slight grooves—running from end to end. It is usually fixed to stones.

SYNONYMS.

1844. *Apomatus ampulliferus*, Philippi. Arch. f. Naturges., Bd. xix, p. 197.
 1861-63. „ „ Mörch. Rev. Serp. Naturhist. Tidssk., p. 363.
 1865. „ „ De Quatrefages. Annel., ii, p. 551.
 1875. „ „ Marion and Bobretzky. Ann. Sc. nat., 6^e ser., t. ii, p. 95, pls. xi and xii, fig. 24.
 „ „ „ Marion. Rev. Sc. nat., t. iv, p. 470.
 1879. „ *globifer*, Théel. Annél. N. Zemb., p. 66, pl. iv, figs. 63—65.
 „ „ *similis* and *ampulliferus*, Marion. Ann. Sc. nat., 6^e sér., t. viii, No. 7, p. 29, pl. xvii, fig. 9.
 1883. „ *globifer*, Levinsen. Vidensk. Meddel., p. 197.
 1884. „ *ampulliferus*, Cérley. Mitt. Zool. St. Neap., Bd. v, p. 209, Taf. xv, fig. 20.
 „ „ *similis*, Langerhans. Zeitschr. f. wiss. Zool., p. 277.
 1885. „ *ampullifer*, Carus. Fauna Medit., i, p. 278.
 1892. „ *globifer*, Marenzeller. Zoolog. Jahrbüch., p. 430, Taf. xix, figs. 8—8 c.
 1893. „ „ idem. Polych. Grundes, p. 14, Taf. iii, fig. 11.
 „ „ *similis*, Lo Bianco. Atti R. Accad. Sc. Nap., vol. v, No. 11, p. 90.
 „ *Omphalopoma fimbriata*, idem. Ibid., vol. v, No. 11, p. 88.
 „ *Apomatus similis*, Marenzeller. Denkschrift. K. Akad. Wiss. Wien, Bd. lx, p. 38 (sep. abd.) p. 15, pl. iii, fig. 12.
 1894. „ *globifer*, Bidentkap. Christ. Vid.-selsk. Forhandl., p. 138.
 „ „ *similis*, De St. Joseph. Ann. Sc. nat., 7^e sér., t. xvii, p. 369, pl. xiii, figs. 415—419.

1897. *Apomatus globifer*, Michaelsen. Polych. deutsch. Meere, p. 188 (after Théel).
 1908. „ *geniculata*, Moore. Proc. Nat. Sc. Philad., p. 361.
 1909. „ *similis*, Fauvel. Assoc. Française Avanc. Sc., p. 697.
 1912. „ *globifer*, Wollebæk. Skrift. Selsk. Krist., Bd. ii, No. 18, p. 112, pl. xli, figs. 1—3;
 pl. l, figs. 4—6.
 1913. „ „ Augener. Zool. Anz., Bd. xli, p. 272.
 1914. „ *similis*, Fauvel. Campag. Scient. Monaco, Fasc. xlvi, p. 359, pl. xxxi, figs. 44—46.
 1917. „ „ Rioja. Anél. Poliq. Cantáb., p. 91.

Habitat.—Under stones between tide-marks, St. Peter Port, Guernsey; and under the same conditions at Herm, in company with the slender tubes of *Filograna*.

It also occurs in the Mediterranean (Philippi, Marion); shores of France (Fauvel); Adriatic (Marenzeller); Finmark (Norman); shores of Cantabria (Rioja).

The collar is less developed than in *Placostegus*, and approaches that of *Protula*, but though narrower it is thicker, and follows a similar arrangement, as, starting from the dorsal edge of the fused collar and alar membrane, it passes as a continuous fold across the ventral aspect to the opposite side. The truncated anterior end after removal of the branchiæ presents a somewhat rounded central elevation, with a fossa between it and the collar.

The *body* of the preserved animal is somewhat stout and short, the posterior region being especially massive, and it tapers only a little to the slightly flattened tail. The anterior region has a broad alar membrane, and the mid-dorsal is distinguished by a long conical elevation, with the apex directed forward and a median furrow, the rest of the dorsum being more or less convex except in the instances where the hollows were filled with ova. The ventral surface is convex rather than flattened, but it has a median groove from end to end, with the exception of the break at the alar fold.

The branchiæ (Plate CXXXII, fig. 2c) are reddish in life and are seven in number on each side. They are of moderate length, somewhat soft and thick, and in the preparations are usually coiled and doubled. The broad filaments taper slightly toward the extremity, and end in a subulate process, the pinnæ extending almost as far—so closely do they approach the tip. The tissue of the filaments is lax, so that doubling readily occurs, and both they and the pinnæ have hypodermic glandular cells, the tissue of the ciliated pinnæ being especially soft, and one moniliform blood-vessel is conspicuous. Instead of the firm, hyaline cuticle of other forms this apparently has a very thin cuticle, the cells and granules of the hypoderm almost reaching the surface. In this connection the occurrence of a broad membranous web on the filaments on each side of the pinnæ in *Apomatus elisabethæ* of the “Challenger”¹ indicates the plastic nature of the organs in this genus.

The operculum (Plate CXXXII, figs. 2b and 2c) is a soft globular enlargement on the end of a branchial filament of the ordinary character as regards general structure and the presence of pinnæ. It consists of a layer of cuticle with a hypodermic granular coat internally, and, moreover, the globe contains several branching structures, resembling modified distal processes, and it may be parasitic, which extend to the free end of the operculum. While thus serving as a plug to the aperture the operculum would also appear to perform a respiratory function, and it is filled with fluid. The filament bearing it tapers little, and the pinnæ pass up to its termination. A constriction then occurs, followed by the slightly enlarged,

¹ ‘Annelids,’ p. 514, pl. liv, fig. 4, etc.

though short, opercular pedicle, which is again slightly constricted at its junction with the operculum. In an example from St. Peter Port the operculum showed no branching filaments, so that these in all probability are branching algoid parasites. Marion and Bobretzky allude to a second operculum on another of the filaments. *Apomatus assimilis* differs in having "crystallins" on the branchial filaments, but perhaps this is only a variety of the above, which sometimes shows pigment-specks at the base of the branchiæ. A second small operculum is occasionally observed in those from the Channel Islands—arising as in the case of the larger from the tip of a branchial filament.

The anterior region carries six setigerous processes (the first bristles being dorsal) on the ventral side of the alar membrane, and six elevated rows of hooks to their ventral edge. All the lateral bristles are directed upward and backward, and have a uniform structure (Plate CXXXII, fig. 2), viz., a straight shaft, narrowed at the insertion, then remaining cylindrical to the curvature at the tip, after which it tapers to a fine point. Serrated wings commence a little below the curvature, widen, and then diminish distally.

The first bristles, which form two conspicuous tufts, present two series, a stronger and a more slender kind. The former has a stout shaft, curved backward at the tip, and with somewhat broad wings. The latter has a slender shaft, the tip is less curved, and the wings are narrow. Both are finely tapered at the tip. These bristles slant obliquely forward and outward from a point a little in front of the first lateral tuft. Though slightly longer, they thus have the same structure as those which follow.

Bristles are absent in the first part of the posterior region, only about twelve to fifteen of the terminal segments having a pair of bristles on each side. The more anterior of these (Plate CXXXII, fig. 2a) have short, straight shafts and sickle-shaped tips, the broad tapering blade having its edge serrated. Toward the tip of the tail, however, the terminal blade is knife-shaped and less curved, a slight enlargement occurring at the end of the shaft. Faint striæ in all cross the tip obliquely from the serrations. Just in front of the tip of the tail a series of longer and more slender simple bristles occur on each side, the finely tapered tips showing no apparent differentiation in the preparations. Marenzeller's indication of a joint has not been observed.

The anterior hooks (Plate CXXXVII, fig. 19) are very diaphanous, with a straight, minutely serrated anterior margin ending inferiorly in a slightly projecting and modified (blunt) main fang—below which a gulf occurs above the prow. The crown is rounded, comes abruptly from the anterior edge, and the posterior outline has a deep indentation. The body of the hook is faintly striated from the anterior face to the base, the outline of the latter trending in a semicircle to the posterior indentation. The anterior edge is rough, and the teeth so minute as to be seen with difficulty in the preparations. The posterior hooks have the process at the crown somewhat narrower, and the curve to the posterior border more abrupt, whilst the body of the hook is smaller and the basal outline less convex. These hooks, as observed long ago, closely approach those of *Protula* in outline and general structure.

Reproduction.—In an example procured at Herm in August numerous ova occurred in the hollows of the body in the tube, so that in all probability they are developed there.

The white tube is more or less sinuous or curved, though in some it is coiled, and shows on its upper surface two slight longitudinal grooves with a flattened ridge between them, and various circular ridges of growth. The aperture is smoothly rounded, and the tube

tapers from the anterior to the posterior end. Occasionally several larger and smaller are in company, and they may touch each other or cross one another on the stone, and in a few the slender terminal region forms a loop in its progress. As a rule the tube is firmly attached to the under surface of the gneiss throughout its entire length.

Marenzeller (1892) gives a figure of a jointed bristle and a hook. The outline of the bristle differs from that of the present form and from that of any known species, by having an indentation on the border of the serrated wing at the tip as if a kind of articulation occurred there. No bristle of this kind has been seen in *Apomatus*, though softened preparations occasionally simulate such a condition—especially under pressure.

De St. Joseph (1894) found *Folliculina ampulla* in the tubes of *Apomatus similis*, Marion and Bobretzky—a species approaching the present very closely. Indeed, so far as can be observed, there is no valid reason for separating *A. similis* from the common species.

Wollebæk (1912) gives a figure which resembles in outline this species. His figure of the hook, however, differs, for instance, in the absence of the gulf behind the inferior spike, but his figure may be imperfect.

Fauvel (1914, p. 361) considers *Apomatus similis*, Marion and Bobretzky, and *A. globifer*, Théel, as identical. The authors just mentioned place weight on the occurrence of a greater number of “crystallins” in the touches of pigment on the branchiæ, and on the presence of the hooks on the second instead of the third bristled segment, whilst they describe and figure differences in the bristles and hooks, the latter being devoid of denticles on the anterior edge, but such is either an abnormality or a misapprehension, and it is probable that the bristles slightly vary.

On the whole, it is probable that the number of species of *Apomatus* may be considerably reduced in future, the modifications of the branchiæ and the differences in regard to bristles and hooks being due either to environment or misinterpretation.

The *Apomatus geniculata* of Percy Moore¹ (1908) seems to be a closely allied and probably identical form.

Miss Pixell² (1920), in her account of the Polychæts of the Scottish National Antarctic Expedition, describes an *Apomatus* (*A. brownii*) which has a small fin and a gap at the base of the terminal blade of the collar-bristles, thus differing from the British species, and making an approach to the condition in the Spirorbids. De St. Joseph makes the uniform character of all the anterior bristles a special characteristic of the genus.

Genus CLXXXIII.—DITRYPA, Berkeley, 1835.

SYNONYMS.

Dentalium, O. F. Müller, Montagu, Desh. 1810. *Pyrgopoton*, Montfiore. Conch. Syst., p. 394. 1819. *Ditrupa*, M. Edwards. Lamarck, ed. 2, v, p. 637. 1825. *Entalium*, Blainville. Man., pl., foss fig. 4. 1827. *Brochus*, Brown. Brit. Conch., ii. 1829. *Cresis*, “Gadus,” Rang. Manual Mollusca. 1829. *Cresis* Costa. Palæont. Neap. 1832–4. *Ditrupa*, Berkeley. Zool. Journ., v, p. 424.

¹ ‘Proc. Acad. Nat. Sc., Philad., p. 361.

² ‘Scott. Nat. Antarctic Exped.,’ vol. vii, Zool., p. 89, fig. 2a.

1835. *Serpula*, Sars. Beskrivelser, p. 52. 1842. *Ditrupa*, Agassiz. Nomenclat., p. 3, Vermes. 1844. *Cadulus* ?, Philippi. Enumeratio, ii, p. 208, t. xxvii, fig. 21. 1844. *Ditrypa*, Philippi. Arch. f. Naturges. 1847. *Gadila*, Gray. Proc. Zool. Soc., p. 159, n. 280. 1848. *Ditrupa*, Brown. Index Pal., i, p. 433. 1851. *Serpula* and *Placostegus*, Grube. Fam. Annel., pp. 91 and 142.

Collar diaphanous, well-developed, edge laciniated, fissured in the mid-dorsal line but continuous ventrally. Branchiæ in two fans of considerable length, the filaments ending in short processes. Pinnæ rather long. Pedicle of the operculum springs from the left branchial fan, and supports a long vase with the calcareous plate on the top. Anterior region of the body of six bristled segments. Tail with two rounded papillæ at the vent. Alar membrane rudimentary, but with a bifid ventral flap posteriorly. Capillary anterior bristles with narrow wings on the tapered tips. Posterior bristles delicate, confined to the caudal region, and of similar structure. Anterior hooks avicular, with numerous small teeth on the anterior edge. Posterior hooks smaller, but agree in structure. Tube shaped like a slender tusk of an elephant, obliquely thinned at the aperture. Surface smooth or marked by faint lines of growth.

1. DITRYPA ARIETINA, *O. F. Müller*, 1776. Plate CXXII, fig. 5—body, fig. 6—branchia, figs. 6a and 6b—tubes; Plate CXXXII, fig. 1—bristles and hooks.

Specific Characters.—Collar diaphanous, deep and thin, with the edges usually laciniated, fissured in the mid-dorsal line, but thereafter continuous from side to side. No alar membrane is visible dorsally. Branchiæ of considerable length, in two fans, the filaments tapering from base to apex, and ending in a short process, which is slightly longer than the adjoining pinnæ, though it is twice as thick, whilst its surface has cilia. The pinnæ are long and so arranged distally that they form a nearly even series at the tip. In life they are banded with red. Pedicle of the operculum springs from the left branchial fan, is long, slender, flattened below, and rounded distally, where it joins the long and shapely vase, with the calcareous, flattened yellowish-green plate on the top. Body widest in front, though it is usually compressed into a cylindrical form by the tube, tapered a little posteriorly, and ending in a conical and somewhat flattened tail, with two rounded papillæ (cirri) posteriorly. Anterior region of six bristled segments; alar membrane rudimentary, but with a bifid ventral flap posteriorly; posterior region of many narrow segments. Anterior bristles, directed upward and backward, enlarged a little above the insertion, remain cylindrical to the commencement of the tip, which tapers to a delicate point and has narrow wings. Posterior bristles confined to segments near the tail; simple, delicate and tapered. Anterior hooks avicular, with numerous small teeth on the anterior edge, and a prominent but not sharp main fang, with only a shallow notch below, and a rudiment of a prow behind it. Posterior outline with only a trace of an incurvation. Body of hook striated. Posterior hooks agree in structure, though fewer and smaller. Tube shaped like a slender tusk of an elephant, with the smooth and circular anterior aperture encircled by an obliquely thinned wall. Outer and thicker parts of wall of tube vitreous, inner layer opaque white (porcellaneous).

Philippi (1844) did not include this genus under the Serpulids.

SYNONYMS.

1758. *Dentale læve curvum album*, Borlase. Cornwall, p. 276, t. xxv, fig. 5.
 „ *Serpula arenaria*, Linnæus. Syst. Nat., 10th edit., p. 787.
 1776. *Dentalium arietinum*, O. F. Müller. Prodr. Zool. Dan., p. 236, No. 2853.
 1783. Figure in Schröter, Em. indic. Conch., vol. ii, pl. vi, fig. 17.
 1803. *Dentalium gadus*, Montagu. Test. Brit., p. 496.
 1818. *Ditrupa subulata*, Lamarck. Anim. s. Vert., 2nd Edit., t. v, p. 637.
 „ „ *coarctatum*, idem. Ibid., p. 599.
 1825. *Dentalium subulatum*, Deshayes. Mém. Soc. hist. nat. Paris, p. 373, pl. xvi, fig. 29.
 1835. *Ditrupa subulata*, Berkeley. Zool. Journ., v, p. 424, pl. xix, fig. 2.
 „ *Serpula libera*, Sars. Beskriv., p. 52, pl. xii, figs. 33 a, b, c.
 1843-53. *Ditrupa subulata*, Chenu. Illust. Conch., livr. 11^{ème}, pl. vii, fig. 13.
 „ *Dentalium strangulatum* var., idem. Ibid., ii, pl. vi, fig. 24.
 1845. *Serpula libera*, Ersted. Fortegnelse, p. 18.
 1851. *Ditrupa arietina*, Sars. Nyt Mag. f. Naturvid., Bd. vi, p. 204.
 „ *Serpula* and *Placostegus libera*, Grube. Fam. Annel., pp. 91 and 142.
 1853. *Ditrypa arietina*, Sars. Nyt Mag., vii, p. 390.
 1854. „ *libera*, Danielssen. Zool. Reise, Norske Vid.-selsk. Skr., p. 125.
 1857. „ *arietina*, Koren. Nyt Mag., ix, p. 94.
 1859. *Ditrupa* „ Danielssen. Kgl. Norske Vid.-selsk. Skrift., 4^{de} Bd., p. 125.
 1861. *Ditrypa* „ idem. Nyt Mag., xi, p. 562.
 1861-3. *Ditrupa cornea*, Mörch. Rev. Serp. Naturhist. Tidsskr., p. 425.
 „ „ *arcuata*, idem. Ibid., p. 425.
 „ „ *gadus*, idem. Ibid., p. 426.
 „ „ *arietina*, idem. Ibid., p. 424.
 1865. „ *subulata*, De Quatrefages. Annel., t. ii, p. 494.
 „ „ *coarctata*, idem. Ibid., p. 495.
 „ „ *libera*, idem. Ibid., p. 495.
 „ *Ditrypa arietina*, Johnston. Cat. Worms Brit. Mus., pp. 273 and 347.
 1867. „ „ Malmgren. Annul. Polych., p. 122.
 1874. „ „ Malm. Annul. Göteb., p. 103.
 1878. „ „ Hansen. Archiv Mat. og Nat. (Christ.), iii, p. 43, pl. iii, figs. 7-11.
 „ „ *gracillima*, Grube. Annul. Semper. (Mém. l'Acad. St. Pétersb.), xxv, p. 279.
 1879. „ *arietina*, Tauber. Annul. Danica, p. 140.
 „ „ *libera*, idem. Ibid., p. 141.
 1880. „ *arietina*, Langerhans. Zeitschr. f. wiss. Zool., xxxiv, p. 121, pl. v, fig. 39.
 1884. „ „ Levinsen. Vidensk. Meddels., p. 198.
 1885. „ „ McIntosh. "Challenger" Ann. (xii), p. 531, pl. liv, fig. 6.
 1891. „ „ Appellöf. Bergens Mus. Aarb., p. 8.
 1893. *Ditrupa subulata*, Lo Bianco. Atti Acad. Sc. Nap., 2 ser., v, p. 87.
 1894. *Ditrypa arietina*, Bidentkap. Christ. Vet. Selsk. Forhandl., p. 139.
 1896. „ „ Appellöf. Berg. Mus. Aarb., xiii, p. 12 (sep. copy).
 „ *Ditrypa arietina*, Roule. Annel. "Caudan," p. 463, pls. xxii and xxv, figs. 12, 13, 14, 15, 32, 33.
 1897. „ „ Michaelsen. Polych. deutsch. Meere., p. 190.
 1898. „ „ De St. Joseph. Ann. Sc. nat., 8^e sér., v, p. 443, pl. xxiii, figs. 249-254.
 1909. „ „ Fauvel. Bull. Inst. Oceanogr., cxlii, p. 65.
 1912. „ „ Crawshay. Journ. M. B. A., vol. ix, p. 347.

1912. *Ditrypa arietina*, Wollebæk. Skrift. Selsk. Krist., Bd. ii, No. 18, p. 119, pl. xlv, figs. 4—9, pl. li, fig. 4.
 1914. „ „ Fauvel. Campag. Scient. Monaco, Fasc. xlv, p. 846.

Habitat.—Dredged in 90—96 fathoms off North Unst, Shetland ; in 90 fathoms 25 miles west of the Blasquet, S.W. Ireland ; in 110 fathoms 30 miles W. of Valentia (J. G. J.).

It frequently occurs in great numbers, N.W. Coast of Ireland (Vidal) ; on the spines of the “ piper ” in Shetland ; Plymouth (Crawshay).

Distribution wide—from the North Sea to the Azores and Madeira ; Sweden (Lovén, Malmgren, etc.) ; off Norway, 300 fathoms, and elsewhere (Sars, Wollebæk, etc.). A variety from Bono Bay, dredged by the “ Porcupine ” in 1870, is characterised by its pale brownish tube and smaller size. Off the shores of France (De St. Joseph). In the “ Challenger ” it was dredged at 823 metres off the Azores, and by the “ Caudan ” in the Gulf of Gascogne, 180—500 metres ; Madeira, 20—40 fathoms, in sand (Langerhans).

The collar, though deep (Plate CXXII, fig. 6), is very thin, and its edges lacinated, whilst its surface is marked by the linear streaks in the preparations, caused by the adpressed branchiæ. It is fissured in the mid-dorsal line, but is continuous from side to side across the ventral surface. No alar membrane is visible dorsally and it appears to be rudimentary.

The branchiæ are of considerable length, arranged in two semicircles of about a dozen filaments in each, and appear to adhere closely together as if they were bound by a delicate web, though this has not been clearly made out, except at the base. The filaments taper from base to apex, and end in a short process which scarcely projects further than the adjoining pinnæ, though it is twice as thick and presents a more distinct central space, whilst its surface has cilia (Plate CXXII, fig. 6a). The pinnæ¹ are long, in a double row, and are so arranged distally that they form a nearly even series and thus give a character to the tip of the branchiæ. Like the filament, they possess no skeletogenous elements, though in the filament the cuticle is thick and tough. The free terminal process of the filaments may have special branchial functions when the animal withdraws into its tube, for they project all round in the space below the opercular plug.

The pedicle of the operculum is long, and springs from the dorsal edge of the left branchial fan, and it remains nearly cylindrical to the tips of the branchiæ, where it dilates into the long and shapely vase with the yellowish-green or dull yellow calcareous plate, 1.20 mm. in diameter, at its tip. The projection of the operculum proper beyond the terminal processes of the branchiæ is noteworthy. In the ordinary spirit-preparations the pedicle lies in the midst of the branchial filaments, and is thus in contrast with the conditions usually seen in other forms. The distal opercular plate is flat and brittle, presenting under the microscope a deep yellow hue, and a minutely cellulo-granular aspect, the margin, however, being hyaline. The pedicle is flattened inferiorly, but toward the base of the opercular vase it is rounded.

The *body* (Plate CXXII, fig. 5), which is 13—16 mm. or more in length in spirit-preparations, has not been observed in the free condition, all being moulded by the tube into a cylindrical form anteriorly, and only a little tapered toward the tail, which has a short conical outline. The anterior region is distinguished by the six pairs of bristles laterally, the achæitous segment in front, and by the fillet with a median notch ventrally—the representative of the

¹ De St. Joseph noted 33—35 pairs of pinnæ.

broad fold in most Serpulids. The posterior region consists of numerous (fifty to fifty-five, De St. Joseph) narrow segments, most of which are devoid of bristles, and it terminates in a somewhat broad, flattened tail, with two rounded and sometimes prominent anal papillæ (cirri). The first segment anteriorly contains the two excretory organs, the canals of which unite to open between the two branchial lobes.

The anterior bristles (Plate CXXXII, fig. 1) dilate a little above the insertion, the shaft then being cylindrical to the commencement of the tip, which tapers to a delicate point, and has narrow wings. The posterior region presents only one or two simple tapering bristles in each segment toward the tail. These bristles are usually slightly curved.

The anterior hooks (Plate CXXXII, fig. 1a) are numerous (220, De St. Joseph) in each row, which runs ventrally from the bristle-tuft. The crown is small, the anterior edge covered with many (twenty to twenty-two, De St. Joseph) regularly arranged sharp teeth, and the main fang is well developed, though not sharp; whilst beneath it is a shallow gulf or notch, with a mere rudiment of a prow, before merging into the inferior border, which is nearly straight. The posterior outline presents only a trace of an incurvation, and the striæ on the body of the hook incline from the front obliquely toward it. The entire hook is thin and translucent. The posterior hooks are fewer in number in each row, and considerably smaller, but their structure is the same. All the hooks when in position have their teeth directed forward.

The tube (Plate CXXII, fig. 6a) is vitreous throughout the greater part of its thickness, but the inner lining is opaque white, and its shape is that of a long and sharp-pointed tusk of an elephant. The anterior aperture is neatly rounded, but not dilated, whilst by the gradual thinning of the outer layer a character is given to it. The posterior end presents a minute aperture. It measures from 25 to 35 mm. in length, and its wider region in front has a diameter of 2 to 2·3 mm. Various structures affect the external surface of the tube, viz., other Serpulids, such as *Hydroides*, *Serpula vermicularis*, and *Spirorbis*, corals (Plate CXXII, fig. 6b), Polyzoa and sponges. It is a favourite site for Lepraliæ. A southern variety from Bono Bay is considerably smaller, the largest being 25 mm. long, and is characterised by its brownish hue. In the Zetlandic examples comparatively few abnormalities occur amongst hundreds. Occasionally a constriction of the shell is observed toward the wide anterior region, or the rings of growth here and there are unusually prominent. Under favourable conditions the delicate posterior end with its greater curvature is entire—forming a needle-like commencement to the tube. Rarely, as in certain Zetlandic examples, a lateral ridge on each side runs from the anterior aperture to the posterior end.

Reproduction.—Langerhans (1880) describes the sperms as colourless, the ova as reddish.

The earlier authors linked this form with *Dentalium* amongst the Mollusks.

Borlase (1758) states that the tube is gently curved and represents the “case” of a sea-worm from Land’s End, but the figure gives no certainty.

This species is not entered in the ‘Fauna Mediterranea’ of Victor Carus (1885), but it was dredged in abundance by the “Porcupine” on the Algerine coast, though the specimens were smaller than the Zetlandic, and had a brownish tint like those procured by the “Challenger” in 50—90 fathoms off Fayal, in the Azores.

De St. Joseph (1898) observes that *Anomalina variolata*, D’Orb., is fixed to several of the tubes.

Genus CLXXXIV.—SPIRORBIS, *Daudin*, 1800.

SYNONYMS.

1759. *Coretus*, Baster. Naturk. Uitspan., p. 48. 1774. *Dinotus*, Guettard. Mém., p. 133 (tab. lxxi, figs. 1, 2). 1800. *Spirorbis*, Daudin. Rec, p. 37. 1803. *Serpula*, Linn., Müller, Montagu, Grube, Turton, etc. 1808. *Charybs*, Montflore. Conch. Syst., i, p. 107. 1810. *Anatomus*, idem. Ibid., ii, p. 279. 1815. *Spirillum*, Oken. N. G., i, p. 381. 1815. *Spirorbis*, Leach. Encycl. Brit. Suppl., i, p. 452. 1818. *Spirorbis*, Lamarck. Anim. s. Vert., vol. v, p. 358. 1820. *Spirorbis*, Schweigger. Handbuch der Naturg., p. 601. 1822. *Spirorbis*, Fleming. Philos. Zool., p. 602. 1825. *Heterodisca*, idem. Edinb. Philos. Journ., p. 247. 1829. *Spirillum*, Eichwald. Zool. Spec., i, p. 257. 1830. *Spirorbis*, Fleming. Edinb. Encyclop., vii, p. 68. 1833–41. *Coretus*, Oken. Allgem. N. G., v, p. 557. 1845. *Spirorbis*, Johnston. Ann. Nat. Hist., xvi, p. 450. 1851. *Spirorbis*, Grube. Fam. der Annel., pp. 92 and 143.

Cephalic collar split dorsally, but continuous ventrally as in *Filograna*. Branchiæ few, four to five, on each side; filaments with terminal processes and a series of pinnules. Operculum spatulate or clavate; in some it acts as a brood-pouch; always the second on the concave side (the right in dextral and the left in sinistral, Pixell). Body typical, ending in an anus with two papillæ. Anterior region of three or four bristled segments and two rows of hooks. Mouth in the centre, with a short palp on each side. Between the anterior and posterior regions is an asetigerous part. Posterior region with eight to forty segments. Thoracic excretory organs unite in the middle line, and have a single duct. Abdominal nephridia simple tubes. Bristles of the first series (collar) are distinctive and differ from second and third, which also have hooks, and occasionally the bristles of the third diverge. Ventral bristles of posterior region geniculate. Anterior and posterior hooks avicular, with a long serrated anterior edge and a modified main fang inferiorly (Pixell). The posterior hooks are smaller. Hermaphrodite. Tube calcareous, coiled, dextral in some, sinistral in others. The genus is cosmopolitan in distribution.

The genus *Spirorbis* was established by Daudin¹ for the forms with flatly rolled shells after the manner of *Planorbis*, but Savigny did not follow him.

The earlier British zoologists, as a rule, paid little attention to the Spirorbids, but Adams and Montagu considerably augmented our knowledge of native species. Writers on Mollusca often alluded to and figured their tubes.

Philippi (1844) gives the characters as:—Operculum calcareous, obliquely truncated; shell small, always spirally wound, branchiæ of few filaments. At the same date Thorpe, in his 'Marine Conchology,' figured a few, *e.g.*, Fig. 1054 (fig. 30), on a piece of stone.

Mörch (1861–1863), in his 'Revisio Critica Serpulidarum,' has twenty-seven species of Spirorbids which he distinguishes by their tubes.

Spirorbis was omitted from its place amongst the Serpulids in Dr. Johnston's 'Catalogue of Worms in the British Museum' (1865), probably from failing health, for he was acquainted with most of the species. Dr. Baird inserted an account of the British forms in the Appendix. As many had been described only from the shelly tubes considerable changes are now necessary.

¹ 'Mollusc. vers. Zooph.,' Paris, 1800.

Agassiz¹ (1866) gave a good account with figures of the development of *Spirorbis spirillum*, and this agrees with the condition of the same form on our shores. The ova are deposited in the tube, the embryo having eyes, bristles and partially developed branchiæ before it leaves the egg. Its pelagic life is brief, and within twelve hours it settles on a suitable site and forms a minute calcareous tube.

Claparède² (1868) alludes to the reproduction of *Spirorbis lævis*, De Quatrefages, in which he found ova in the first two segments of the abdomen. These ova made their way through the wide peduncle to the operculum, where they developed. The cavity of the peduncle is separated from that of the operculum by a membrane, which must be pierced by the ova or absorbed. The spermatozoa occur behind the third segment of the posterior region.

Levinsen³ (1883) enters nine species in his list of northern Polychæta, and in addition to the nature of the tube, he uses the structure of the collar-bristles in separating them.

De St. Joseph⁴ (1894) describes the development of his *Mæra pusilla* (*Spirorbis pusilloides*, Bush), in which the ova occur in the two anterior segments of the abdomen, the succeeding region having the sperms. Whilst the cavity of the peduncle is in communication with the coelom, the developing ova in the operculum are separated by an oblique calcareous plate, which, however, may permit the passage of ova into the transparent operculum. The embryo has two eyes and a frontal palpocil, three segments and a rudimentary digestive canal containing the brownish-red yolk. *S. pusillus* is closely related to *S. Pagenstecheri*, De Quatref.

Miss Schively⁵ states that *Spirorbis borealis* has two breeding seasons, viz., from the middle of June to the middle of July, the other extends through the month of August. The eggs escape through the operculum, which has a moveable translucent plate of lime. The reproductive glands occur on each side of the stomach. She appears to place ova and sperms in the same region. Miss Bush thinks she refers to *Spirorbis Pagenstecheri*, De Quatrefages, and further adds that this is probably the species studied by Fewkes⁶ as *Sp. borealis*; also, that the *Sp. spirillum* of Agassiz (1866) is *S. borealis*, Daudin = *Sp. spirorbis*, Linnæus. She further notes that the embryos in *Sp. validus* and *S. granulatus* (non L.) in the operculum had well-developed bristles, and each was concealed by a white patch, which under pressure split into short rods, which dissolved in acid.

An able and well-illustrated memoir on the genus *Spirorbis* and the species placed under it was published by MM. Caullery and Mesnil⁷ in 1897. They gave a brief historical account, the taxonomic characters of note, a description of the species, with a table for diagnosis, and lastly they considered the position of the Spirorbids in the Family Serpulidæ, their phylogeny and distribution. They place less value on the form of the tube than on the structure of the animal, though in their synoptical table such forms the primary division, viz., tube

¹ 'Ann. Lyceum Nat. Hist. N. York,' vol. viii, p. 318, pt. vii, figs. 20—25.

² 'Suppl. Annel. Neap.' p. 159.

³ 'Meddel. nat. Forh. Copenhagen,' p. 205.

⁴ 'Annal. Sc. nat.,' 7^e sér., t. xvii, p. 352, pl. xiii, fig. 391.

⁵ 'Proc. Acad. Sc. Philad.,' 1897, p. 153—160, pls. i—ii.

⁶ On the larval form of *S. borealis*, 'American Naturalist,' xix, p. 247, pls. xi, xii.

⁷ 'Bull. Sc. France et Belgique, ser. iv, ix, p. 185, pls. vii—x.

dextral and tube sinistral. Caullery and Mesnil state that all dextral forms have the operculum on the right side and all sinistral on the left. Bush, again, considers it improbable that any species could turn in both directions. An abridged table, partly applicable to the British species, is appended :—

Tube dextral	{ Four pairs of bristle - tufts on thorax (sub. - gen. <i>Paradexiospira</i>).	{ Fourth setigerous segment with dorsal bristles. Fourth setigerous segment without dorsal bristles. }	{ Collar bristles with spinous web and gap		<i>S. cancellatus</i> , Fabr.	
			{ Collar bristles without the gap			
	{ Three bristled thoracic segments (sub. gen. <i>Dexiospira</i>). Embryos incubated in—	Tube.	{ Collar bristles without the gap.	{ Operculum saucer-shaped.	{ Ten to sixteen abdominal segments. }	<i>S. spirillum</i> , L.
		Operculum.	{ No sickle-shaped bristles in third bristle-tuft.	{ Collar bristles without gap.		
Tube sinistral	{ Three bristle-tufts on thorax.	{ Collar bristles with gap, incubation in—	Tube.	{ Talon of operculum without protuberances externally.	{ Collar bristles with fine serrations	<i>S. borealis</i> , Daud.
			Operculum.	Helmet-like.	{ Coarse serrations	<i>S. mediterraneus</i> , Caull. & Mes.
						<i>S. militaris</i> , Clap.

Miss Bush (1908) made an important contribution to the subject of the Spirorbids in her volume on the Tubicolous Annelids from the Pacific. She relied much on the opercula and the collar-bristles, the hooks being less fully dealt with. She gives a brief historical summary of the group, including many features of interest. She points out various modifications of the operculum, which often pushes forward several plates, and is of opinion that a new calcareous plate may be developed or renewed on the same side as before. In her review the following forms have the embryos developed in the tube, viz., *S. spirorbis*, L., *S. spirillum*, L., and *S. asperatus*, Bush; whilst in *S. granulatus*, L., *S. validus*, Verrill, *S. Stimpsoni*, Verrill, and *S. quadrangularis*, Stimpson, there is opercular development. She found in the opercular embryos of various species, such as her *Spirorbis abnormis*, *S. granulatus* (?) and *S. validus*, a white patch which split under pressure into short rods which dissolved in acid. She thought this a calcareous substance ready for secreting the tubes, or that the mass would enable them to sink rapidly, both views, however, being doubtful. She states that in *S. spirorbis* strings of embryos with well-formed setæ have been found on the dorsum, having apparently passed from an opening in the body-cavity behind the thorax. This differs from the condition in Britain. She discards the classifications of both De St. Joseph and Caullery and Mesnil, and prefers to arrange the species according to the structure of the bristles of the collar, and the structure of these bristles is certainly of great importance.

A. In the forms having the distinct fin-like base there are differences; the serrations on the edge of the blade are fine, and the spines on the basal fin coarser. In *Sp. borealis*, Daud., the type-species, there are three to five odd setæ in the third anterior fascicle with sickle-shaped fringed edges.

B. The serrations on the edge of the fin and of the blade are coarse. Ex. *Sp. militaris*.

C. The form with the rounded fin gives rise to those in which the fin is defined by a more or less definite notch, which entirely disappears, forming simple tapered blades. Ex. *Sp. Pagenstecheri* and *Sp. pusillus*.

D. The form with angular fin gives rise to a simple blade, broadly angular at the base. *Sp. armoricanus*, De St. Joseph.

E. Instead of being angular, the blade becomes broadly rounded at the base. Ex. *Sp. lævis*, De Quatref.

F. The blades become long, narrow, regularly tapered and similar in all three fascicles. Ex. *Sp. Perrieri*, Caullery and Mesnil.

She did not notice that the basal "fin" was double.

Miss Irene Sterzinger¹ (1909) gives at the end of her paper on the Spirorbids from Suez Caullery and Mesnil's key to the species and a figure indicating right and left spiral arrangements in the genus—taking the commencement of the spire from the mouth—the reverse of the growth of the tube.

In dealing with this genus Miss Pixell² (1912) pointed out that the collar bristles are distinctive, either having simple blades or possessing a fin-like expansion at the base of the blade (tip); but as there are intermediate forms between the two, she suppresses for sinistral forms Caullery and Mesnil's sub-genus *Romanchella* with the simple blades and places all sinistral forms with three setigerous segments in the French authors' sub-genus *Læospira*. The second thoracic segment has only bristles with the ordinary tips; whilst the third in addition has some with sickle-shaped tips. In the abdominal region the segments range from eight to forty, and the bristles are generally geniculate. The anterior and posterior hooks are similar, the front edge having numerous fine teeth, with one larger than the others. She adopted in the main the classification of the Spirorbids of Caullery and Mesnil in her contribution to the Serpulids of the Pacific Coast of North America, basing, however, her main groups on the dextral or sinistral condition of the tube, her sub-genera of the dextral forms being *Paradexiospira* (three and a half thoracic segments), *Dexiospira* (three thoracic segments); whilst under the sinistral fell *Protolæospira* (four thoracic segments), *Paralæospira* (three and a half thoracic segments), and *Læospira* (three thoracic segments). Her further groups rested on incubation in tube or operculum, on the structure of the operculum, and that of the collar and other bristles.

In a paper on the Polychætes of Vancouver Island and the Pacific Coast Miss Pixell³ (1912) makes some useful remarks on the classification of the Serpulids, and especially of the genus *Spirorbis*, of which she appends a table giving the characters of the species.

In a recent account of the Spirorbids of Sweden, Folke Borg⁴ (1917) classifies the five representatives according to the number of the thoracic bristled segments, the opercular or non-opercular development, the dextral or sinistral arrangement of the tube and the structure of the bristles.

Much has yet to be accomplished in the synonymy of the species, especially as varieties of the common forms have been described as distinct species, and it is not always easy to consult the original specimens even if these have been preserved. It is unsafe, for instance,

¹ "Deckel u. Brutpflege bei *Spirorbis*," 'Zeitschr. f. wiss. Zool.,' lxxxviii, p. 602, 1907, 13 figs. and pl. xxxi.

² 'Proc. Zool. Soc.,' 1912, part iv, p. 792.

³ *Op. cit.*, p. 784.

⁴ 'Zool. Bidrag. Uppsala,' Bd. v, 1917, pp. 15—38, 16 text-figs.

to depend largely on the shape of the operculum as Philippi¹ and Marion and Bobretzky² did in the case of *Spirorbis cornu-arietis*, for the collar-bristles agree with known types.

Division I.—Tube Dextral.

A. Incubation in Tube.

a. Tube vitreous; four thoracic segments; last thoracic segment without dorsal bristles; first bristles without notch and basal fins, though a trace of the latter may occur.

1. SPIRORBIS VIOLACEUS, *Levinsen*; var. CAULLERYI, *McIntosh*, 1916. Plate CXXXII, figs. 3, 3*a*, 3*b*, and 3*c*—bristles, figs. 3*d* and 3*e*—tube; Plate CXXXVI, fig. 20—hook,

Specific Characters.—Collar typical; branchiæ four in number on each side—normal. Body with three bristled thoracic segments. Collar-bristles generally have no distinct gap at the base of the tip, where the serrations are coarse, or a modified one. The bristles of the third tuft show sickle-shaped forms, with serrations at the tip. Bristles of the posterior region have their tips bent nearly at a right angle (geniculate) and coarsely serrated. Tube vitreous, slightly bluish when fresh, coiled from left to right, and raised, so that the aperture is often on the summit of the spire. Whorls boldly ridged, and the ridges affect the aperture, which is generally transversely elongated. The whorls form a conical mass, with a flattened base of attachment in the centre of which is the primary coil. Anterior hooks thin, diaphanous, with a straight, finely toothed anterior edge, and a spur inferiorly; upper margin curved a little downward, convex next the serrated edge; lower margin nearly straight. Reproduction cœlomic.

SYNONYMS.

1780. *Serpula granulata*, O. Fabricius. Faun. Grœnl., p. 380.
 1861–3. ? *Spirorbis granulata*, Mörch. Natur. Tidsskr., p. 434.
 1878. *Spirorbis verruca*, McIntosh. Trans. Linn. Soc., ser. 2, Zool., p. 509.
 1883. ? „ *violaceus*, Levinsen. Vid. Meddel. naturh. Forh., 1883, pp. 202 and 209, Tab. ii, fig. 8, Tab. iii, fig. 19.
 1897. „ „ Caullery and Mesnil. Bull. Sc. Fr. et Belgique, t. xxx, p. 197, pl. vii, fig. 3.
 1905. „ „ Bush. Tubicol. Annel. Pacific, p. 242, pl. xli, figs. 1 and 2, pl. xlii, figs. 8–12.
 1909. „ „ Fauvel. Bull. Inst. Oceanogr., cxlii, p. 53.
 1911. „ „ idem. Ibid., No. 194, p. 38.
 1912. „ „ Pixell. Proc. Zool. Soc., p. 794.
 „ „ *violaceum*, Wollebæk. Skrift. Vidensk. Krist., Bd. ii, No. 18, p. 113, pl. xlv, fig. 5.
 1914. „ *violaceus*, Fauvel. Campag. Scient. Monaco, xlv, p. 330.
 1916. „ *Caulleryi*, McIntosh. Ann. Nat. Hist., ser. 8, vol. xviii, p. 187.

Habitat.—On the under surfaces of stones in tidal pools in Guernsey and Herm. It is by no means common.

¹ ‘Arch. f. Naturges,’ 1844, p. 195, pl. vi, fig. 8.

² ‘Ann. Sc. nat.,’ 6^e sér., t. ii, p. 99, pl. xii, fig. 27.

The ordinary *S. violaceus* has been found elsewhere in Greenland (Levinsen); British Columbia, on shells (Bush); Spitzbergen (Fauvel); Vancouver Island (Pixell).

The cephalic collar is normal and forms a sheath for the branchiæ which are about four in number on each side, and do not offer any noteworthy peculiarity.

The operculum is circular and hollowed out distally like a saucer, with a short stalk, or process like a reversed cone. In young examples it is circular, forming a saucer-shaped disc, but in the older forms it is sometimes nail-shaped; that is, the circular shape is lost by an extension of one edge toward the stalk. Externally is the clear outer investment of the rim of the operculum, within which is a radially arranged layer at right angles to it; then follows a broad belt of circular fibres with strong longitudinal fibres converging to the stalk. The calcareous investment is very brittle.

The *body* is typical in outline, and has three bristled segments. The first or collar series (Plate CXXXII, figs. 3*a*, 3*b*, and 3*c*) consists of bristles which have no distinct gap at the base of the tapered terminal blade, or a modified one. The former kind occurs in one group, the straight shaft slightly dilates at the shoulder, from which the tip is bent backward and coarsely serrated, the serrations next the shoulder being perhaps less distinct than those which follow. The other group presents a distinct differentiation of the base of the terminal blade, the separated part at the shoulder having finer serrations, the edge beyond (bearing the marked serrations) being separated by a distinct step. The base of the blade has five or six teeth, at least, in lateral view, and antero-posteriorly this part appears to form a spiked collar to the anterior edge of the bristle. The serrations on the terminal blade vary, that figured being one with coarser points. There is much in the structure of the collar-bristles that agrees with *S. vitreus*, O. Fabr., for in that form a series of stages occurs—from the bristle without a trace of a gap—to one in which there is a modified gap, which forms a wide indentation at the base of the tip, and which includes the serrations of the basal double web as shown by Mesnil. The second bristle-tufts of the region have straight shafts and tapered, winged tips, bent at a slight angle (Plate CXXXII, fig. 3). The bristles of the third tuft have in the group a slightly curved tip (sickle-shaped), with the serrations only at the tip, as described by Caullery and Mesnil.

The bristles of the posterior region have broad, tapering tips, bent nearly at a right angle, with the edge coarsely serrated.

The hooks (Plate CXXXVI, fig. 20) are very thin and diaphanous, and it is not easy to get a perfect lateral view. The anterior edge is straight, very finely serrated, and ends inferiorly in a larger spike or main fang. The upper edge is convex next the serrated border, and slopes slightly downward to the thin posterior edge. The lower margin leaves the main fang with scarcely an incurvation. These thin hooks readily assume various outlines, especially anteriorly.

The tube (Plate CXXXII, figs. 3*d* and 3*e*) is vitreous and peculiarly coiled so that the aperture is on the summit of the spire. The whorls are boldly ridged, and the ridges affect the shape of the aperture, which is sometimes transversely elongated. The whorls thus form a conical mass with a flattened under-surface, in the centre of which is the primary coil. The shape is therefore like an irregular blunt cone, and the shell is very hard and glistens like pinkish porcelain. In lateral view the tube quite differs from *S. violaceus* of O. Fabricius and Levinsen, the latter showing a flat spire of a different character, the aperture, for instance,

being at the circumference of the flattened disc, whereas in *S. Caulleryi* it is generally on the summit of the elevated spire in the centre of the shell. The two narrow ridges of *S. Caulleryi* also diverge from the broad, rounded elevations of *S. violaceus*.

There is considerable difficulty in reconciling the various descriptions of *S. violaceus*, Levinsen (1883), with the form under consideration. He describes four thoracic segments, each with dorsal bristles. Those of the collar-segments have a broad or dilated wing to the tip, so that it is obliquely triangular, acuminate, and with serrations and striæ. The base of the tip is rounded, not angular as in *S. spirillum*, with which it agrees in having no "bite." The basal serrations are coarser than those above. The pectiniform uncini of the anterior region, usually distinctly toothed in other forms, have a margin minutely striated transversely, but without teeth. No mention is made of the operculum. The tube has three distinct coils, the exterior not coming from the base; one or two being visible, and never ascending. There are two deep grooves, and three rounded ridges, the ends of the latter affecting the aperture. Levinsen's species somewhat approaches *S. vitreus*, O. Fabricius, from the Arctic seas, as usually observed on pebbles and stones, the apertures of the tubes of both species being on the summit of the coils, but the camerated condition of the sulci of the outer whorls in the Arctic form is not seen in the southern species. Miss Bush enters *S. vitreus* as a British species, viz., from Devonshire on shells, but there may be confusion between this and *S. violaceus*. Again, Levinsen states that the tube of *S. vitreus*, with the exception of the keels and foramina, is similar to that of *Spirorbis cancellatus*, O. Fabricius, though in two examples he examined the dorsal bristles of the fourth segments were absent, and the striæ of the bristles of the collar were less distinct. Sterzinger (1909) again figures the operculum as conical, whilst the collar-bristles, as shown by Caullery and Mesnil, have a gap, fine serrations occurring on the basal web, coarser serrations on the distal blade. The sickle-shaped forms are serrated along the concave (anterior) edge. The cancellated margin (as if punctured) of the dextral, vitreous, translucent, boldly ridged tube is noteworthy.

In the presence of a distinct though modified gap or "bite" above the crenulate web at the base of the tip of the collar-bristles it diverges from Levinsen's type, though it agrees with the older specimens mentioned by Caullery and Mesnil. Some of these bristles show a differentiated base without a distinct gap, and thus there is considerable variety. The operculum does not materially differ from the figures and description of *S. violaceus* given by the French authors, the ringed and saucer-shaped tip being evident.

The *Serpula granulata* of O. Fabricius in the structure, arrangement and colour of the tube appears, as Levinsen states, to come near this form. It was found under stones and on *Balani* and *Mytili*.

Fleming (1825) refers to a species mentioned by Montagu, and which he terms after its discoverer *S. Montagui*, as having one very thick, rounded, glossy, white volution. The shell is very convex, and wrinkled transversely, with a minute central cavity at the top, sometimes only a suture. The animal is of a buff colour, with ten ciliated rays, and a sub-funnel-shaped operculum, having a brown, ciliated hyaline margin. It was procured on a *Haliotis* from Guernsey.

In Brown's 'Illustrations of Conchology' (1827) the figure of *Spirorbis conicus* (Plate I, fig. 58) resembles this species.

Fauvel (1909) observes that the tubes of this form are common on large pebbles of sand-

stone. They are thick, translucent, with three longitudinal ribs, and prolonged into teeth at the aperture. They are vitreous, translucent, or have the aspect of chalcedony—which accounts for the title, “Kalkedonagtigt” of Levinsen, only their nature is calcareous and not siliceous. Internally is a violet membrane, whence their specific name, which makes the tube double.

Sterzinger (1909), after Caullery and Mesnil, figures the operculum as concentrically ringed and the first bristles as devoid of a gap.

b. Tube opaque; three thoracic segments.

2. SPIRORBIS SPIRILLUM, *Linnaeus*, 1760. Plate CXXII, figs. 9—9*b*—opercula and branchia; Plate CXXXII, figs. 6—6*b*—bristles, 6*c*—6*d*—tubes, 6*e*—operculum, 6*f*—hook.

Specific Characters.—Collar normal. Branchiæ four on each side, and the terminal processes of the filaments are short (in the preparations) so that they do not project beyond the pinnæ, which also are short. Operculum a shallow vase with a foot or process (talon), the lower edge of which is crenate. No brood-pouch. Body typical. Upwards of twenty segments, three anterior segments with bristles; abdominal segments eighteen to twenty. Two papillæ at the anus. Collar-bristles have no gap at the base of the terminal blade. They have long, straight shafts, dilated at the shoulder, and the terminal blade is sharply bent backward, tapered and coarsely serrated. Hooks somewhat triangular in outline, the apex being superior. Anterior edge finely serrated and the main fang not conspicuous. Tube dextral, quite smooth, more or less translucent, the aperture in some being raised so as to give a lax aspect to the spire. It is flattened on the attached surface.

This species has a dextral tube, and falls under Caullery and Mesnil's *Dexiospira* with three thoracic segments. Incubation is carried on in the tube. The first bristles have no basal notch or fin. Posterior region with ten to twenty setigerous segments.

SYNONYMS.

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 1747. „ *spirorbis*, Linnæus. Westgotha Resa, p. 198.
 1757. „ *cochleæ*, Baster. Philos. Trans., vol. i, p. 277, Tab. viii, fig. 6 *b*.
 1758. „ *spirillum*, Linnæus. Syst. Nat., ed. x, p. 786.
 „ „ *spirorbis*, idem. Ibid., p. 787.
 1761. „ *spirillum*, idem. Fauna Suecica, p. 535.
 1762. *Coretus Eschara minima millepora crustaceæ cellulis tubiformis*, Baster. Natuurkun. Uitspan., vol. i, p. 48, Tab. ii, fig. 5 *b*.
 1767. *Serpula spirillum*, Linnæus. Syst. Nat., ed. xii, p. 1264.
 „ „ *spirorbis*, idem. Ibid., ed. xii, p. 1265.
 1769. *Tubulus minimus lævis*, etc., Martini. Conch., vol. i, pp. 25, 59, Tab. iii, figs. 21 *a, b, c*.
 1776. *Serpula spirillum*, O. F. Müller. Zool. Dan. Prod., p. 236, No. 2854.
 1780. „ „ Fabricius. Fauna Grœnland, p. 376.
 „ „ *porrecta*, idem. Ibid., p. 378.
 1784. „ *spirillum*, Walker. Test. Minuta, figs. 13 and 14.
 1788. „ „ Pallas. Nova Acta Acad. Petrop., t. ii, p. 236, Tab. v, fig. 21.

1788. *Serpula porrecta*, idem. Ibid., p. 229.
 „ „ *spirorbis*, Da Costa. Hist. Nat. Test. Brit., p. 22, Tab. ii, fig. 11.
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 „ „ *cornea*, idem. Ibid., p. 5, tab. i, figs. 33, 34 and 35.
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 „ „ *sinistrorsa*, idem. Ibid., p. 504, Edit. Chenu, p. 219.
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 „ „ *lucida*, idem. Ibid., p. 201.
 „ „ *spirorbis*, idem. Ibid., p. 201.
 1810. *Spirorbis crustacides*, Montfiore. Syst., vol. ii, p. 35 (*fide auct.*).
 1811. *Serpula lucida*, Laskey. Wern. Mem., vol. ii, p. 412.
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 „ „ „ „ and *spirorbis*, Dillwyn. Cat. Rec. Shells, p. 1072.
 „ „ *lucida*, idem. Ibid., p. 1075.
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 1819. *Serpula lucida*, Brown. Wern. Mem., vol. ii, p. 534.
 „ „ *spirillum*, reversed, Turton. Dict., p. 150.
 1825. *Heterodisca lucida* and *Montagui*, Fleming. Edin. Philos. Journ., vol. xii, p. 247.
 „ *Spirorbis spirillum*, idem. Ibid., vol. xii, p. 245.
 „ *Serpula spirorbis*, Leach. Encycl. Brit. Suppl., p. 452.
 1827. *Spirorbis spirillum*, Brown. Illust. Conch., vol. iii, tab. i, figs. 41, 42, 53 and 54.
 „ *Serpula lucida*, idem. Ibid., figs. 56 and 60.
 1828. „ *spirorbis*, De Blainville. Dict. Sc. nat., t. lvii, p. 429.
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 „ „ „ „ Fleming. Edin. Encyclop., vol. vii, p. 68.
 „ „ *lucidus*, idem. Ibid., p. 69.
 1836. „ *spirillum*, Templeton. Mag. Nat. Hist., vol. ix, p. 233.
 1841. „ *sinistrorsa*, Gould. Invert. Mass., p. 9, tab. ii, fig. 4.
 1843-5. „ *spirillum*, Chenu. Illust. Conch., vol. iii, tab. i, fig. 2.
 „ „ „ „ Johnston. Ann. Nat. Hist., vol. xvi, p. 451.
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- " " Verrill. Rep. U.S. Com. F. and F., p. 662.
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- " " *spirillum*, Fauvel. Bull. Mus. Hist. Nat., p. 93.
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 1917. „ „ Borg. Zool. Bidr. Uppsala, Bd. v, p. 20, text-figs. 3 and 4.
 1919. *Circeis* „ Chamberlin. Mem. Mus. Comp. Zool., vol. xlviii, p. 478.
 1920. „ „ idem. Canad. Arctic Exped., vol. ix, Part B, p. 28.
 „ *Spirorbis* „ Eliason. Faun. Öresund., p. 80.

Habitat.—Abundant on zoophytes all round the British shores; on Fuci, Algæ and *Corallina officinalis* (Fleming); on *Flustra*, etc. The variety (*Sp. sinistrorsa*) is found on crabs and lobsters (Montagu). Firth of Forth (Leslie and Herdman). Loch Fyne; Loch Alsh (J. G. J.); Dublin Bay, Dalkey Sound, and West Coast of Ireland (Southern); Plymouth, on *Sertularia abietina*, etc. (Crawshay), and south bank of the River Yealm, Plymouth; Torquay (Elwes).

Abroad it has been noted as follows:—

N. Pacific Coast and N.E. Coast of N. America (Moore); Greenland (Michaelsen and Ditlevsen); Coast of Korea (Levinsen); Vancouver Island (Pixell); Spitzbergen and North Sea; common in Finmark (Norman); Franz-Joseph-Land (Augener); Cape Fox, Alaska, and to Santa Barbara, California, and on the eastern shores of North America (Bush); Canadian North-West Territories (Chamberlin); Smith's Sound (Brit. Museum); Barents Sea (McIntosh); Kara-Havet (Levinsen); Mediterranean (if *Spirorbis Pagenstecheri* is same); New England and Atlantic Coast, U.S.A. (Verrill).

The collar agrees with that in other Spirorbids in being widely split dorsally, but continuous ventrally. Its connection with the membrane of the anterior setigerous region is also normal. The branchiæ are four on each side, and the terminal processes of the filaments are short, so that they do not project beyond the pinnæ, which thus form a more or less even tip (Plate CXXII, fig. 9*b*).

The operculum forms a shallow vase with a foot or process beneath, the edge of the latter being crenate (Plate CXXII, figs. 9 and 9*a*, and Plate CXXXII, fig. 6*e*). There is no space for opercular embryonic development in this species.

The body is widest in front, and gradually tapers to the tail.

The collar-bristles (Plate CXXXII, fig. 6) are characterised by the absence of the gap near the base of the terminal blade. They are comparatively small, have long straight shafts, which dilate on reaching the distal shoulder, the terminal region being sharply bent backward, tapered to a fine point, and rather coarsely serrated along the edge, especially at the base. The figure of the collar-bristle as given by Miss Pixell¹ from the Pacific Coast of North America diverges considerably from the British form, the tip being shorter and broader. The other bristles conform to the usual type. The second fascicle consists of simple winged bristles (Plate CXXXII, figs. 6*a* and 6*a'*), and the third appears to have similar bristles. The posterior bristles have the tips bent at an angle (geniculate) (Plate CXXXII, fig. 6*b*), and usually project little in the preparations.

The hooks (Plate CXXXII, fig. 6*f*) are somewhat triangular in shape, with a series of sharp teeth along the anterior edge, which terminates inferiorly in a larger process at a slightly

¹ 'Proc. Zool. Soc.,' 1912, pl. lxxxviii, fig. 8*c*.

different angle, representing the main fang. The inferior edge is more or less straight, with a small incurvation behind the main fang.

Reproduction.—Ova in various stages of development occur in the coelomic cavity of females in summer, and nearly ripe sperms in the males at the same time.

Claparède and Mecznirow¹ (1868) remark that this species, their *S. Pagenstecheri*, is not hermaphrodite; also that, so far as they can learn, the larva is not developed in the operculum, and that their form had the young in the body-cavity. They describe two young stages, in the first of which the cephalic lobe has a long whip of cilia in front, two eye-specks anteriorly, a larger pair behind, a prototroch on a prominent ring, an enlarged segment and several smaller behind it. Mouth and anus are present. The next stage has a lobulated cephalic lobe with similar eye-specks, and the body shows traces of more numerous segments anteriorly. It is, however, doubtful if they refer to the same form as here described.

The tube (Plate CXXXII, fig. 6*d*) is dextral, that is, the coil is from left to right, is quite smooth, and more or less translucent, the aperture in some being raised, so as to give a lax aspect to the spire. It is flattened and less smooth on the attached surface—where fixed to the zoophyte. Other tubes, again, have a more elongated spiral, the aperture with the last coil being raised, so that it projects considerably above the rest.

In the plate of Pallas (1788) the animal is figured in its tube with four branchial plumes, but no operculum.

This is the *Spirorbis lucidus* of Montagu, who, along with Fleming, sometimes confounded another form, viz., *Sp. borealis*, so common on Fuci, with *Sp. spirillum*. He (1803) describes it as frequently having the aperture turned upward, with the volutions rising spirally on each other and attached by the small end. He notes that it seldom occurs on stones, shells or crabs, like *S. borealis*. He thought that a smaller kind on *Corallina officinalis* was different.

Mörch separated *S. lucidus*, Montagu, from *S. spirillum*, but most authors consider it a variety of the latter. He included three varieties under the title, viz., the typical *S. lucidus*, var. β , *cornea*, and var. γ , *grœnlandica* (*S. porrecta*). In the British Museum is a specimen labelled *S. lucidus* from Smith's Sound, Halifax, N.S., 80.9.27.66. The annelid is of a deep red colour, and the collar-bristles have no web, as in *S. spirillum*. The tube is smooth, cylindrical, with a rounded aperture, and the umbilicus is filled by the early coils. The operculum is flat. The confusion arising from dependence on the appearance of tubes without investigation of the inhabitant has been considerable, and the present is another instance. *S. spirillum* and its varieties are almost cosmopolitan. The variety *sinistrorsa*, Montagu,² is a larger race than that usually found on zoophytes, and examination of the fresh form would set doubts at rest. It was thought to be a distinct form by W. Cocks. It occurs on lobsters' claws and on shells. It is figured by Walker ('Minute Shells,' figs. 13 and 14), and appears to be *S. armoricanus*, De St. Joseph. Montagu (1803) describes it as having a semi-pellucid, glossy, white shell, with two or three reversed volutions usually placed laterally, sometimes coiled on each other. It is somewhat wrinkled transversely, but has no longitudinal irregularities. The aperture is orbicular, diameter 1 line. It appears to be a reversed *S. spirillum* occurring on Crustacea. Johnston includes it under *S. lucidus*. Caullery and Mesnil found intermediate forms between *S. armoricanus* and *S. spirillum*.

¹ 'Zeitschr. f. wiss. Zool.,' Bd. xix, p. 199, Taf. xvi, figs. 2 and 2A.

² 'Test. Brit.,' ii, p. 504.

The *Spirorbis Beneti* of Marion¹ approaches this form closely.

In Cunningham and Ramage's (1888) figure three pairs of setigerous processes symmetrically placed occur on the anterior region. The structure of the first group is, however, recognisable.

Miss Bush (1905) states that the terminal blades of the first bristles in the American forms are finely serrate; indeed, in some they are scarcely visible.

Some are inclined to link on the true *Spirorbis Pagenstecheri* from the Mediterranean to this species, but the southern form develops ova in its operculum, which the northern does not. Claparède and Mecznirow, however, mention that the species, which they term *S. pagenstecheri*, did not develop ova in the operculum, so that further investigation is necessary. Lo Bianco (1909) found the Neapolitan species with ova and larvæ from June to September.

3. SPIRORBIS MEDIUS, *Pixell*, 1912. Plate CXXXIII, figs. 3—3c—bristles and hooks.

Specific Characters.—Collar typical. Branchiæ fourteen, seven joined at their bases on the right side and six besides the operculum on the left. Each filament has a thin membranous flap, which overlaps the next, thus forming a series of imbricate semilunar membranes inside the base of the collar (Pixell). Body with a wide thoracic membrane on the right side which almost envelops the whole animal. Calcareous plate of the operculum is nail-shaped and 1.5 mm. in its long axis, the free surface being concave. The talon projects obliquely and has large wing-like expansions at the sides. The collar-bristles are intermediate between simple serrated blades, and those with a gap and fin. The second bristles are simple, rather broadly winged forms, and, besides these, in the third are sickle-shaped forms with distinctly serrated tips. Abdominal bristles geniculate with boldly serrated edges. Thoracic uncini triangular with about twenty fine teeth, the great fang being long and clavate, and with a narrow gulf behind it. Tube large, flat, thick and opaque, slightly roughened, but without definite lines of growth. A slight median ridge or sometimes one on either side. Aperture entire (Pixell).

SYNONYMS.

1912. *Spirorbis medius*, Pixell. Proc. Zool. Soc. Lond., p. 800.

1914. „ „ Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 149.

1915. „ „ idem. Irish Sc. Invest., No. 3, p. 49.

Habitat.—Blacksod Bay, in dense masses, under stones between tide-marks (Southern). Elsewhere it occurs in British Columbia (Pixell).

This species of *Spirorbis* was originally described by Miss Pixell from the shores of British Columbia. Mr. Southern lately procured it in Blacksod Bay on the West Coast of Ireland, and I am indebted to him for examples.

The cephalic collar is well developed, forming a sheath for the base of the tentacles. The filaments of the branchiæ, which are fourteen in number, terminate distally in a tapering subulate process, which extends considerably beyond the pinnæ. The nail-shaped operculum

¹ 'Ann. Sc. nat.,' 6^e sér., t. viii, p. 29, pl. xvii, fig. 8.

presents a minutely cellular or reticulated structure when viewed by a high power from above, and a series of concentric rings. A considerable process or talon occurs beneath it, the lower edge of which varies in outline—sometimes being irregular, at other times smooth. The distal concavity frequently contains mud and minute algæ.

The *body* has the typical coil, three bristled segments occurring in front, and twenty to thirty posteriorly. The most powerful muscle seems to be that on the concave side of the coil. The collar-bristles (Plate CXXXIII, fig. 3) have straight shafts dilating into a broad web at the base of the tip, which is bent backward, is of moderate length, finely tapered and minutely serrated. The basal web is striated, each of the striæ ending in a sharp point, whilst on the distal blade the striæ slant obliquely to the serrated edge. The second tuft has bristles with rather broad wings, and the blade tapers somewhat suddenly to a very fine point, so as to give a character to the bristle. The third tuft has both winged (Plate CXXXIII, fig. 3a) and sickle-shaped bristles, the edge of the latter being serrated.

The posterior bristles (Plate CXXXIII, fig. 3b) are minute, and project little beyond the surface. They are geniculate, the tip being bent nearly at a right angle to the shaft and coarsely serrated.

The anterior hooks are stated by Miss Pixell to be of ordinary shape, with about twenty teeth. In outline (Plate CXXXIII, fig. 3c) they are somewhat triangular, the anterior edge having a closely set series of fine teeth, the last, representing the main fang, being larger with a narrow gulf behind it.

The tube is described by Miss Pixell as dextral, large and flat, thick and opaque, slightly roughened, but without definite growth-lines. A slight median ridge is present, and sometimes one on either side; the aperture has, however, an entire margin and measures 2 mm. across. The Irish examples from Blacksod Bay were in dense clusters on stones and shells, sometimes only the aperture being visible, whilst the tube itself formed a lax spiral quite different from the original account of Miss Pixell, though it is still large. In lateral view the elongated spires of some of the masses gave an unusual depth to the Spirorbid coating. Some examples, indeed, formed an elongated spiral tube after the manner of the horn of the Indian antelope or even that of the koodoo. Originally the tube appears to be small and flat, then as the annelid increases in size the tube thickens, becomes loosely spiral and keeps pace with the growth of sponges or other encrusting growths, so that its rounded and dilated aperture (trumpet-like in some) is free. From Miss Pixell's description the tubes follow another mode of growth under different circumstances.

Reproduction.—Mature specimens were found in September, and incubation takes place in the tube, where strings of the ova occur.

B. Incubation in Operculum.

4. SPIRORBIS PUSILLOIDES, *De St. Joseph*, 1894; an var. S. PAGENSTECHEI, *De Quatrefages*.

Specific Characters.—Cephalic lobe bounded by a collar of the normal type and ciliated. Branchiæ three on each side, the filaments terminating in a process about the length of a barbule. The second on the right bears the operculum, which is cylindro-conical and has a brood-pouch guarded posteriorly by a calcareous (?) plate. Body 1·20 mm. in length;

three thoracic segments. Two nephridia debouching by a single aperture in the median line behind the branchiæ. Collar-bristles without a step beyond the basal web, the third series having two bristles with curved and serrated tips. The following bristles are said to be large and sickle-shaped (De St. Joseph). Hooks of the two posterior thoracic segments resembling those of *Spirorbis borealis*. Ova (few) in the anterior abdominal segments, those behind containing sperms. Developed in the operculum.

SYNONYMS.

1837. ? *Spirorbis pusilla*, Rathke. Fauna de Kryn, p. 117; Mém. l'Acad. St. Petersb., iii, p. 407.
 1864. *Spirorbis pusilla*, Grube. Insel Lussin., p. 92.
 1880. „ *Pagenstecheri*, Langerhans. Zeitschr. f. wiss. Zool., Bd. xxxiv, p. 123, Taf. v, fig. 42.
 1894. *Mera pusilla*, De St. Joseph. Ann. Sc. nat., 7^e sér., xvii, p. 351, pl. xiii, figs. 388—392.
 1897. *Spirorbis pusillus*, Caullery and Mesnil. Bull. Sc. Fr. et Belg., t. xxx, p. 202, fig. D, p. 190.
 1905. „ *pusilloides*, Bush. Tubic. Annel., pp. 250, 254, 255, 260, 261 and 267.
 „ „ *Pagenstecheri*, idem. Ibid., pp. 254, 255, 257, 258, 260, 261, 265.
 1912. „ *pusilloides*, Pixell. Proc. Zool. Soc. Lond., p. 797, pl. lxxxviii, figs. 9a and 9b.
 1914. „ „ Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 148.
 1915. „ „ idem. Irish Sc. Invest., No. 3, p. 49.

Habitat.—Clare Island and Blacksod Bay on shells of *Mytilus* and *Trochus* (Southern). St. Vaast; Arcachon, on oysters (De St. Joseph); on *Lithothamnion*, and on *Purpura* at St. Vaast-la-Hougue (Caullery and Mesnil); Madeira—Teneriffe, on algæ (Langerhans); British Columbia (Pixell).

Tube 1 mm. in diameter, fragile, in a nautiloid spiral, with a central umbilicus and three whorls.

In his original description of *Spirorbis pusilla*, Rathke gives two coils to the tube, with its longitudinal keel, like the *S. carinata* of Lamarck. This form may be a variety of *S. pagenstecheri*. He found it on mussels and the blades of Fuci.

A single example of the last species, viz., *Spirorbis pusilloides*, Rathke and De St. Joseph, kindly sent by Mr. Southern, has alone been under examination, and the collar-bristles in this instance had no gap above the web, and might pass for those of *S. spirillum*. Mr. Southern, however, states that he has seen all intermediate forms between this and the typical one with the differentiation at the base of the blade. Caullery and Mesnil also found a simple geniculate condition of the collar-bristles in preparations forwarded by Baron De St. Joseph. Whether the violet pigment on the gut of *S. Pagenstecheri* and the red on *S. pusilloides* denotes more than variation is uncertain. The species was first described by H. Rathke and later by De St. Joseph under the name of *Mera pusilla*,¹ but Miss Bush,² seeing that the specific name was used by Rathke in 1836 for a species from the Black Sea, proposed the present title. It chiefly occurs on shells of oysters, though Southern found it on mussels and *Trochi*. There remains doubt as to the connection of this form with that described by Rathke, and as to its relationship with *Spirorbis Pagenstecheri*. Both develop eggs in the operculum, and in all probability *S. pusilloides* is a variety of the other. The single preparation unfortunately was so injured that no hooks could be observed.

¹ 'Ann. Sc. nat.,' 7^e sér., t. xvii, p. 351, pl. xiii, figs. 388—392.

² 'Tubicolous Annelids from the Pacific' (Harriman Alaska Exped.), 1908, p. 250.

5. SPIRORBIS PAGENSTECHERI, *De Quatrefages*, 1865. Plate CXXXVII, fig. 23—collar-bristle.

Specific Characters.—Collar normal. Branchiæ normal. Operculum shaped like a shako, with a circular calcareous plate distally, and acts as a brood-pouch. Body with three anterior and from eight to twelve setigerous segments posteriorly. Collar-bristles somewhat geniculate, with a differentiation at the base, the web having finer serrations than those which follow on the blade; or without a differentiation, the blade being a simple serrate (geniculate) process. Bristles of the third series have some serrate sickle-shaped forms.

Anterior hooks of the normal shape, with about twenty minute teeth along the anterior border. The main fang is somewhat short and blunt. The tube is abundant on *Zostera* at Naples, is dextral and pure white, with a ridge along the summit of the last coil. The aperture is circular.

SYNONYMS.

1863. *Spirorbis spirillum*, Pagenstecher. Zeitschr. f. wiss. Zool., Bd. xii, p. 486, Taf. xxxviii et xxxix.
 1865. „ *Pagenstecheri*, De Quatrefages. Annel., t. ii, p. 491.
 1868. „ „ Claparède and Mecznirow. Zeitschr. f. wiss. Zool., Bd. xix, p. 37, Taf. xvi, fig. 2.
 „ „ „ Claparède. Ann. Neap., p. 443.
 1875. „ „ Panceri. Atti Soc. Ital. Sc. Nat., vol. xviii, p. 535.
 1893. „ „ Lo Bianco. Atti Accad. Sci. Napoli, vol. v, p. 92.
 1897. „ „ Caullery and Mesnil. Bull. Sc. Fr. et Belg., t. xxx, p. 201, fig. 8a—b.
 1917. „ „ Rioja. Anél. Poliq. Cantáb., p. 82.

Habitat.—Probably on the southern coast, and as *S. pusilloides* in Blacksod Bay (Southern).

Elsewhere it occurs at Naples (Claparède); between Cette and Agde (Pagenstecher); Shores of Cantabria (Rioja); Isles of Gambia (Fauvel).

Pagenstecher¹ (1863) found a species between Cette and Agde on seaweeds and shells which he thought was *Spirorbis spirillum*, but as afterwards shown by De Quatrefages, it belongs to a different species (*S. Pagenstecheri*, De Quatrefages). He recognised the hermaphrodite condition, the ova being present in the anterior region of the abdomen and the sperms in the posterior; whilst the development of the eggs took place in the brood-pouch—with the disc-like operculum on its extremity. He studied the development of the eggs in March, the form of the early larva with its prostomium and two lateral lobes, the large body-segment and its caudal lobe, and the various later stages to the secretion of the tube with its transverse lines. Four eyes appear in the free larva, two smaller in front, and two larger behind—nearly in a line with the collar-bristles; whilst in front are the branchiæ as simple lobes; in the centre of the body is the reddish-brown gut and three pairs of lateral bristles. The great breadth of the anterior region, like that of certain Terebratulids, is striking in the third stage, and the appearance of two translucent ovoid bladder-like bodies on each side of the gut anteriorly is also noteworthy in this and later stages, the last having four branchiæ on each side with filaments and pinnæ, an operculum on the right side, four eyes, and four pairs of bristles, the collar-bristle being figured in a recognisable condition. The first bristles to appear are the lateral, the collar bristles being developed when the lateral are present.

¹ 'Zeitschr. f. wiss. Zool.,' Bd. xii, p. 486, Taf. xxxviii and xxxix.

The tube is dextral, turning from first coil from left to right, somewhat flattened on stones, and with three ridges in the fully developed forms. The last whorl is large, and a process projects in some on the outer border. The central umbilicus is distinct with the apex in the pit. On the whole, the tube is more regularly coiled than that of *S. granulatus*, which often presents considerable irregularity in its coils and occasionally is flattened, this especially affecting the central umbilicus, these changes being emphasised in the older examples. Moreover, in the Northern form, the three ridges are more boldly marked and the grooves deeper, whilst there is a tendency to projections of the terminations of the ridges around the circular aperture of the thicker tube.

The collar-bristles of *S. Pagenstecheri* quite differ from those of *S. granulatus*, being devoid of a gap, and the serrations are so minute on the tapering portion of the blade as to be indistinguishable, whilst at the broad web at the base distinct though fine serrations pass from the edge obliquely downward and backward (in regard to the anterior edge) over the web. Only three pairs of bristles seem to be present—the collar and two others and in the third tuft a sickle-shaped bristle occurred. Caullery and Mesnil give a good figure, but the lithographic ink obscures certain of the finer characters, such as the very slight concavity beyond the spinous basal web of the tip. A figure (Plate CXXXVII, fig. 23) is given for comparison, especially as the species may yet be met with on our southern shores. It is common at Naples on stones and *Zostera*.

Langerhans¹ (1880) describes the tubes on algæ as showing all the coils, which are marked by transverse lines, whereas those on stones are less regular and with a smaller aperture. The anterior region is reddish, the glandular coating of the intestine dark violet and the eggs edged. He figures the collar-bristle with a differential web, but no distinct gap, whilst the sickle-shaped form from the third tuft is serrated distally with a slight wing inferiorly. He found ova in the first four abdominal segments and sperms posteriorly.

Miss Bush (1908) places this form under those in which the “fin” of the collar-bristle is defined only by a more or less definite notch, which “entirely disappears,” forming simple tapered blades, which leave the shaft at an angle. This would not appear to be the rule in examples from Naples and Ireland. Her *S. pusilloides* is the *Mera pusilla* of De St. Joseph, but as Rathke used the specific name *pusilla* for a species from the Black Sea, she suggested the term mentioned. So far as can be seen, it would appear to be a young form of *S. Pagenstecheri*.

Division II.—Tube Sinistral.

A. Incubation in Tube.

6. SPIRORBIS GRANULATUS, *Linnaeus*, 1767. Plate CXXII, figs. 7—7*h*—body, operculum, branchia, ova and larvæ; Plate CXXXII, figs. 5, 5', 5'', 5*a*, 5*c*—bristles, 5*d*—tubes; Plate CXXXIII, figs. 12 and 12*a*—operculum and branchiæ; Plate CXXXVII, fig. 22—collar-bristle; Plate CXXXVIII, figs. 15 and 15*a*—hooks.

Specific Characters.—Cephalic collar split dorsally, but entire ventrally. Branchiæ pale, or with a tinge of red, especially at the base of the filaments, ten in number; filaments taper

¹ ‘Zeitschr. f. wiss. Zool.’ Bd. xxxiv, p. 123, Taf. iv, fig. 42.

from base to apex, and end in a somewhat long non-ciliated process, which in life projects beyond the pinnæ, though in the preparations it is obscured by these. Filaments are pinkish, except at the tip, and have a strong band of muscular fibres at the base of the richly ciliated pinnæ. Operculum funnel- or vase-shaped, thin when seen on edge, stalk gradually dilating from the base upward, and with a brown margin, both stalk and operculum being pinkish or reddish. Body widest anteriorly, tapered posteriorly, and of a pale grass-green hue, or pinkish; it ends with a rounded papilla on each side of the anus; three pairs of bristle-bundles anteriorly, including the collar-fascicle, whilst the pale posterior region has nineteen to twenty segments. The colour of this species is reddish or greenish; a bright red hue tinges the opercular stalk as well as the base of the branchial filaments. The contained ova are likewise of a reddish colour. The collar-bristles are directed forward, have a long straight shaft which dilates as it approaches the backwardly curved tip, with serrations increasing in strength toward the notch, and then a few distinct serrations followed by a more finely serrated edge of the tapered blade. They are mingled with more slender, simple bristles having tapering tips. The two following pairs of bristles are simple, with spear-shaped slightly curved tips. Posterior bristles (two in each segment), with tips bent at an angle and resembling an ancient long-toed boot, with a serrated edge. Anterior hooks avicular, with a long serrated anterior edge, the main fang inferiorly being peculiarly modified and set at a slightly different angle. Posterior hooks smaller, but of similar structure. Tube sinistral, two deep grooves, and three ridges on the outer whorl; often umbilicated.

Few forms appear to have had greater vicissitudes in nomenclature than *Spirorbis granulatus*, L., a species which essentially differs from the *Spirorbis granulatus*, L., of Caullery and Mesnil¹ from Greenland and Nova Zembla, since the globular form of the operculum as figured by the French authors, no less than its ovigerous character, separate it from the present species, which, as Fleming² truly said in 1825, occurs "on old shells, but more frequently on the under side of loose stones about low water-mark, very common," and is especially abundant on the rocks and stones in rock-pools at St. Andrews. It is remarkable that two forms so closely resembling each other in many particulars should diverge so widely in regard to reproduction. Another name will be necessary for the northern form with the opercular brood-pouch, unless it is to be supposed that such a modification is possible in this example of a plastic group. In the earlier accounts of the species no mention of opercular incubation is made, and as the great majority of authors appear to have interpreted this as the type, it remained for those who first described the opercular brood-pouch to characterise the form anew, and not to confuse the synonymy by adhering to the old title. It is certain that the majority of British and other northern zoologists interpreted the description of Linnæus as applicable to the common littoral species which deposits its ovigerous string in the tube.

SYNONYMS.

1767. *Serpula granulata*, Linnæus. Syst. Nat., xii, p. 1266.
 1768. " " Pennant. Brit. Zool., iv, p. 359.
 1769. *Tubularia viscera avium*, Martini. Conch., pl. iii, fig. 23.

¹ 'Bull. Sc. France, Belgique,' t. xxx, p. 216, pl. x, fig. 26.

² 'Edin. Philos. Journ.,' vol. xii, p. 244.

1776. *Serpula granulata*, O. F. Müller. Zool. Dan. Prodr., p. 236, No. 2857.
 1780. „ „ O. Fabricius. Fauna Grœnl., p. 380, n. 375.
 1791. „ „ Gmelin's Linnæus. Syst. Nat., p. 3741.
 1797. „ *sulcata*, Adams. Linn. Trans., iii, p. 254.
 1803. „ *granulata*, Montagu. Test. Brit., vol. ii, p. 544.
 1807. „ „ and *sulcata*, Matou and Rackett. Linn. Trans., viii, pp. 241 and 255.
 „ „ „ Donovan. Brit. Shells, iii, fig. 100.
 „ „ „ Turton. Brit. Fauna, p. 201.
 1811. „ *granulata*, Laskey. Wern. Mem., vol. i, p. 412.
 1817. „ „ Dillwyn. Recent Shells, p. 1074.
 1818. *Spirorbis granulatus*, Brown. Wern. Mem., vol. ii, p. 534.
 1819. *Tubularia viscera avium*, Turton. Conch. Dict., p. 150.
 „ *Serpula granulata*, var., Turton. Dict., p. 151.
 1820. „ „ Savigny. Syst. Annel., p. 74.
 1825. *Tubularia viscera avium*, Wood. Index Testaceologicus, p. 185, pl. xxxviii, fig. 11.
 „ *Spirorbis granulatus*, Fleming. Edinb. Philos. Journ., xii, p. 244.
 1827. „ „ Brown. Brit. Conch., pl. i, fig. 47.
 1828. ? *Serpula granulata*, De Blainville. Dict. Sc. nat., t. lvii, p. 429.
 1830. *Spirorbis granulatus*, Fleming. Edinb. Encycl., vii, p. 68, pl. ccv, fig. 2.
 1836. „ „ Templeton. Mag. Nat. Hist., ix, p. 233.
 1843-45. *Tubularia viscera avium*, Chenu. Illust. Conch., p. 71, pl. xxv, figs. 18, 19.
 1844. *Spirorbis granulata*, Thorpe. Brit. Mar. Conch., p. 10, fig. 64.
 1845. „ *granulatus*, Johnston. Ann. Nat. Hist., xvi, p. 451.
 1851. *Serpula granulata*, Grube. Fam. Annel., pp. 93 and 143.
 „ „ „ Sars. Nyt Mag., 6^{de} Bd., p. 205.
 1853. *Spirorbis* „ Stimpson. Invert. Grand. Manan, p. 29.
 1859? „ „ Danielssen. Kgl. Norske Vid.-selsk. Skrift., 4^{de} Bd., p. 125.
 1861. „ „ idem. Nyt Mag., xi, p. 57.
 1865. „ *granulatus*, De Quatrefages. Annel., t. ii, p. 491.
 „ „ „ Johnston. Cat. Worms Brit. Mus., p. 348.
 1867. „ *granulata*, Parfitt. Cat. Annel. Devon, p. 36.
 „ „ *granulatus*, Malmgren. Annul. Polych., p. 231.
 1874. „ „ (L.), Malm. Göteborg Fauna, p. 103.
 1879. „ „ Tauber. Annul. Danica, p. 141.
 1883-84. „ „ Levinsen. Vidensk. Meddel. Naturhist., p. 201, pl. iii, figs. 9, 10.
 1893. ? *Serpula granulata*, idem. "Hauchs" Togter, p. 355.
 1894. *Spirorbis granulatus*, Bidentkap. Christ. Vid.-selsk. Forhandl., p. 140.
 1897. „ „ Michaelsen. Polych. deutsch Meere, p. 192 (= *Serpula granulata*, L., and *S. sulcata*, Mat. and Rack).
 1908. „ „ Bush. Tubicol. Annel. Pacific, p. 247.
 1913. „ „ (L.), Fauvel. (= *Spirorbis carinatus*, Levinsen, and *Spirorbis affinis*, Levinsen). Bull. Mus. Hist. Nat., p. 93.
 „ „ „ Augener. Zool. Anz., Bd. xli, p. 273.
 1916. „ „ McIntosh. Ann. Nat. Hist., 8 ser., vol. xviii, p. 189.
 1920. „ „ Eliason. Polych. Öresund, p. 80.

Habitat.—Common on sand- and other stones in pools between tide-marks, St. Andrews (E. M.), and a few on stones in similar situations at Guernsey and Herm; Scalloway (W. C. M.); Cork Harbour on *Chiton* (J. D. Humphreys); on mussel-valves, So. England

(J. G. J.). The species is probably widely distributed in foreign waters, especially in the north, but it would be unsafe to specify without careful re-examination.

The branchiæ (Plate CXXXIII, fig. 12*a*) are pale, or reddish at the base, ten in number, and the cuticle of the filaments is thin, so that the hypodermic elements form the main support. The filaments taper from base to apex, and end in a somewhat long non-ciliated process (Plate CXXII, fig. 7*a*), containing a blood-vessel, and which in life projects beyond the pinnæ, though in the preparations these extend even beyond it. The pinnæ are long throughout, and are richly ciliated. No skeletogenous elements are present in these or in the filaments, which, however, have a band of muscular fibres passing from the base to the tip, but they do not appear to enter the terminal process. The entire branchial system, indeed, is eminently contractile and under voluntary control. The cilia on the pinnæ are large and long, and also appear to be under the control of the animal, since they remain quiescent for a time, and then commence to vibrate rapidly. The branchiæ, on the approach of danger, are shortened, grouped together, and drawn in, the operculum following and closing the tube. The pinnæ have a dotted aspect from the grouping of the cilia in tufts, though this may only be apparent; moreover, the movement of each pinna is independent of the others, so that it bends downward, jerks inward and performs various motions with celerity and accuracy. The wall is composed of firm mucoid (hypodermic) cells, and a greenish blood-vessel occurs in the centre, the fluid therein being devoid of corpuscles. In contraction the pinnæ are, by their muscular elements, only slightly shortened and narrowed, so that when the branchial apparatus is again unfolded the elastic nature of the tissues readily restores them to the former size.

The operculum (Plate CXXXIII, fig. 12) is funnel- or vase-shaped, hollow, like a saucer, at the distal end, and gradually dilating from the stalk upward. The distal plate is calcareous (effervescing under HCl), and the muscular fibres pass from the pedicle to the enlarged opercular region, in which they spread out in a fan-like manner, to be attached to the distal cup. No trace of a central cavity exists in this form, though a calcareous mass occurs in the centre below the operculum, and its shape differs from that in forms with opercular development. Frequently around the edge of the operculum is a fringe of delicate filamentous algæ, stalked and thecate Infusoria and other organisms. When viewed laterally the opercular plate is thin.

When removed from its tube, the anterior region of the *body* is pale, or reddish, but the rest is of a pale grass-green. It is widest anteriorly, and tapers posteriorly to a bluntly conical tail, a rounded papilla being on each side of the anus. The anterior region has three pairs of bristle-bundles, whilst the posterior region consists of nineteen to twenty segments. No cilia were observed on the anterior region, but they occurred dorsally on the swollen greenish posterior region, and were vigorous toward the tail; indeed, by far the greater part of the body is supplied with cilia.

The alimentary canal is richly ciliated, and thus the contained cells and granules are kept in active motion—a stream of them proceeding posteriorly, and, it may be, escaping by a rupture of the body-wall. The intestine contains much dark mud, carried in by ciliary action, amidst which are many diatoms and other organic particles, spicules of sponges, and a considerable quantity of sand. The intestinal canal is enlarged immediately behind the anterior region, and such may represent the stomach, which is muscular, tough, and

furnished with granular glands, for a gizzard-like portion is marked off by constrictions in front of it. It is ciliated from this region to the vent, and elongated collections of particles are often observed in motion in the interior of the gut. Gregarines are common in the intestine, and they are active, contracting and elongating the anterior end, which is now bulbous and again pointed, and bending their bodies to and fro. They are much more active than the Gregarines of Nemerteans, the contractions and elongations of the entire body and the tapering of both ends being noteworthy. The myophan striation is most marked in contraction. The body is minutely granular, and the large nucleus is about the centre. In the coelomic space numerous minute ovoid bodies—tapered at one end—also occurred, and they had a tendency to group themselves in circular masses. These represent the male elements.

Two brownish-green granular glands (Plate CXXII, fig. 7*a*, *a*) lie obliquely on each side of the gizzard-like region of the alimentary canal, and they open by a dorsal pore at their junction.

The first, or collar-bristles, differ from those which succeed not only in size, but in direction and structure. Each (Plate CXXXII, fig. 5, and Plate CXXXVII, fig. 22) consists of a long straight shaft, slightly dilated and flattened as it approaches the tip, which is curved backward, and with fine serrations at its rounded base, their size, however, increasing as the gap is approached, three or four being especially prominent next the notch, then the blade is finely serrated to the delicately tapered extremity. Amongst these are a shorter series of more slender bristles with simple tapering tips. This bristle-tuft is directed forward nearly in a line with the long axis of the body, and the bristles are longer and stronger than those which follow. Moreover, as had been suspected, the boldly serrated region at the base of the tip is double—a modification of the ordinary wing. In an example from St. Andrews, in which the collar-bristles had apparently been broken, the terminal blade was finely tapered and translucent without evident trace of serrations, whilst the basal webs were coarsely spinose. In a very young specimen barely visible to the naked eye the collar bristles appeared to have no gap in the basal web. The two tufts of bristles which succeed are simple, with slightly curved spear-shaped tips (Plate CXXXII, fig. 5*a*), the last pair having the tips of the bristles somewhat broader. The second tuft has several bristles with sickle-shaped tips, the concave edge being characteristically serrated—that is, nearly at right angles to the axis of the tip.

The posterior bristles are placed in pairs on each edge of the segments of the region, and in outline they somewhat resemble an ancient long-toed boot with the sole (edge) serrated. They diminish in size from before backward.

The anterior hooks (Plate CXXXVIII, figs. 15 and 15*a*) have a long and minutely serrate anterior edge, but the main fang inferiorly is short in lateral view, and when looked at on edge is flattened and bifid. Whilst the dorsal outline slopes downward to the posterior border, the ventral edge, slightly incurving behind the main fang, is nearly horizontal. It is difficult to make out the exact nature of the posterior outline from their flexibility and the manner in which they adhere to each other. The teeth on the anterior edge are downwardly directed, long and sharp. The posterior hooks do not differ in structure, but are smaller.

The greenish circulatory fluid is carried forward by a dorsal vessel, which is often curved in each segment, over the alimentary canal, and backward by a ventral trunk.

Habits.—It is very hardy in confinement, living far from the sea in a shallow glass vessel for months, a little fresh water being added to the sea water at intervals. The stones to which the tubes were attached were covered with *Clava multicornis*. So sensitive are the annelids that they dart inward on the approach of a foreign body. At intervals small pale masses are ejected from the tubes, being the ejectamenta from the rectum propelled forward by ciliary action and perhaps by a jerk of the tail, as stated by Dr. Williams, since it frequently jerks the posterior extremity when removed from its tube, though no *débris* was observed issuing on these occasions.

Reproduction.—In this species (March 1st) the ova lie along the intestine—some opposite the stomach, others behind, and thus they differ in position from those of *S. borealis*, which lie chiefly posteriorly and tint the region reddish. In the first week of March the ova are larger than those of *S. borealis*, and, in confinement in the laboratory, they are larger than in those fresh from the rocks. On breaking open the tubes of those in confinement in June a number of salmon-coloured ova were found toward the smaller end. They were firmly attached by an elongated hyaline process to the inner surface of the tube (Plate CXXII, fig. 7e). In each string are about thirty ova arranged for the most part in a double row, and all contained embryos which showed very active ciliary motion at one end like the embryos of *Doris*. A single free cell often accompanied the embryo (Plate CXXII, fig. 7f), which, when liberated, swam by aid of the cilia. Several free larvæ (Plate CXXII, fig. 7g) also occurred in the vessel, presenting the usual trochophore outline, viz., an ovoid body and a ciliated ring (prototroch), part of the body in certain positions projecting beyond the ciliated ring. Two eye-specks are present (Plate CXXII, fig. 7h). A posterior bristle or two appear in front of the posterior end, and one or two pairs of the anterior bristles also occur.

Moreover, breeding appears to have gone on for some time, since the stones in the vessel have numerous minute tubes just visible to the naked eye, and the contained forms are not fully developed (Plate CXXII, fig. 7). The tube at this stage appears to be smooth. The branchiæ are only sparsely divided, each filament having two richly ciliated pinnæ (*b, b*) and a non-ciliated terminal process (*a*). The pinnæ are capable of various movements, have mucoid hypodermic cells, and their cilia are somewhat longer than the diameter of the pinnæ. The operculum seems to be a hollow process, with a calcareous concretion (*e*) in the enlarged region below it, and this is readily fractured under pressure. Bristles are now developed, and have in miniature the characteristic outlines of those of the adult. The colour of the young form with its opercular stalks is pinkish by transmitted light, the branchiæ being pale. The tubes are coiled like rams' horns, or simply curved, and a few are elongate-spiral, like an Indian antelope's horn. Some of the tubes were empty or tenanted only by Diatoms, so that even at this early stage enemies destroy them.

On the whole, comparatively little change takes place in the development of this species. The eyes may be of use to it in its pelagic existence and in selecting its site; they then disappear. The anterior portion develops into the operculum, the branchiæ budding from the opposite side of the same region, whilst the bristles appear, and the secretion of the minutely granular tube goes on. The oil-globules in the embryos are of a rich salmon-colour.

The tube (Plate CXXXII, fig. 5d) is sinistral, turning from right to left, and strongly grooved—making in large forms three conspicuous ridges. When on a clean surface of

sandstone the aperture is in a line with the tube, but where the tube is covered by Lepraliæ, compound ascidians and other growths, or hampered by other tubes, the rounded aperture is curved upward, and thus is out of line with the tube. One character is the great size of the last whorl, which rapidly increases from the small original coil. Usually a dimple occurs in the centre. Some of the tubes are irregularly coiled, and in many a tendency to form a terminal process at the end of each ridge is evident. When the tube is dissolved by HCl a transparent, hyaline membrane is left, the larger outer coils presenting neither wrinkle nor transverse fold, whilst the early coils in the centre have so many that they resemble rouleaux of transparent discs. When lying in a coil of the tube of *Pomatocerus* the aperture is directed slightly upward.

In a young example from St. Andrews, about one-third grown, the tube was perfectly smooth, rounded, and less closely coiled than usual. Such is probably a variety or abnormality and may have some relation to Montagu's *S. corrugata*.¹ The eight branchiæ may belong to a young form. Yet Caullery and Mesnil (after Langerhans) describe it as distinct, with the first bristles devoid of a gap. In a rather small example from a stone in a tidal pool at St. Andrews in which only a single groove occurred on the tube, the structure of the bristles corresponded with that of the many examples of *Sp. granulatus* around it. It would thus seem that the single groove may occur as a variety. In a larger form only one groove and one ridge were distinct, but faint traces of the other occurred on minute examination. Besides the adults, numerous minute young with smoother shells occur on the stones. Various irregularities of the tubes are common, irrespective of those crowded together. Swarms of the young of this species occasionally cover a limpet as specks just visible to the unaided eye.

This form agrees with Montagu's description (1803), having an opaque-white shell, of two volutions, deeply grooved longitudinally, and with a round aperture. He distinguished it from his *S. heterostrophus* by the whorls not being reversed, and by the deeper sulci. It is not clear what he means by the inner volution being nearly obsolete, only marked by the third or interior ridge. "This is white like glass-enamel, but not so glossy; whereas *S. heterostrophus* is dull brownish or dirty white, and never grows to half the size." He found it on rocks, on the under surface of loose stones at Milton, and on old shells, also at Guernsey on *Haliotis* "in company with a species of *Serpula* very different from any example of the genus hitherto described."² "It has one very thick, rounded, glossy, white volution, very convex and wrinkled transversely, with a minute umbilicus at the top, and sometimes only a suture."³

It is possible that the *Cornu Hammonis littoris* of Plancus,⁴ Tab. i, fig. 8, M. and N., *Spirorbis*, or *Vermiculus saxi et lignis adhærens* refers to *S. granulatus*, the most common form on rocks and stones.

Martini (1779) figures a *Spirorbis* with a grooved tube, the examples being clustered together on a rock-surface or other area, and closely resembling *S. granulatus*, though the locality is not stated.

Turton's *Spirorbis granulatus*, var. *A. fasciata*, a shell with two brown bands on the top

¹ 'Montagu, 'Test. Brit.,' ii, p. 502.

² He may refer to *Spirorbis Caulleryi*.

³ 'Test. Brit.,' ii, pp. 501—502.

⁴ Janus Plancus Ariminensis, 'De Conchis,' Venitiis, 1739.

between the ribs, about half the size, and found amongst the roots of Fuci and corallines, and on stones and shells, is probably a young form of this species.

Fleming¹ (1825) describes the tube of this form as having three ridges and two grooves, with two whorls and a distinct central cavity. There are a few irregular transverse wrinkles. It is found on old shells, but more frequently on the under-surface of loose stones. He quotes Montagu's description of the animal, and it is clear that he refers to this common form.

Cuvier's figure of *Spirorbis communis* shows no ridges on the shell.

Alex. Agassiz (1866) gave an interesting account of the development of a form which he termed *Spirorbis spirillum*, Gould, but which appears to have a development similar to that observed in *Spirorbis granulatus*, L. Agassiz's form was attached mainly to Fucus. It differs from Pagenstecher's species, since the ova are not developed in the operculum. The ova, which are reddish brown, are found in strings of two rows on each side of the alimentary canal in the naked, enlarged part of the body behind the anterior region. After deposition they lie between the body and the tube. He found the pelagic condition of the larva lasted no longer than eight or ten hours, the period between its escape from the egg and its fixation in a tube, for he mentions that "the young *Spirorbis* has attained quite an advanced stage of growth when it leaves the tube of the parent and swims freely about (in search of a place of attachment) during a night at the outside." It frequently happened that in a single night the sides of the glass vessel were covered with tubes. The "tentacles" (branchial filaments) arise on the outside, the new appearing nearer the median line on alternate sides, and not in pairs, the corresponding tentacles on each side of the middle line being of different lengths. The two eyes are prominent, and can generally be traced in the adult. The first tentacle appears on the right, the next on the left, and only later the rudiment of the odd opercular tentacle covering the right tentacle. Two pairs of the anterior bristle-bundles appear, and then a third, whilst the posterior extremity has lengthened, the anal cili have nearly disappeared and two indistinct articulations occur behind the collar. Two additional tentacles have arisen between the first pair. Subsequently the slightly elongated posterior region has two bristle-bundles, the tentacles bifurcate, and the opercular tentacle is more distinctly funnel-shaped. About this stage the young *Spirorbis* escapes from the egg and leads a short free life, and in less than twelve hours has secreted its calcareous tube. The further changes are chiefly confined to the anterior extremity.

S. granulatus, as described by Langerhans² (1880), is a different form. The tube is purplish, shining, and with transverse streaks between the two lateral ribs. The collar-bristles have a distinct gap, and the serrations are coarser than in the British form, but Langerhans' figures are somewhat diagrammatic. This form appears to have an opercular brood-cavity.

Levinson (1883) considers that this is not the *Spirorbis granulatus* of Fabricius nor that of Langerhans. He notes that occasionally the three ribs are continued at the aperture of the tube into teeth (var. *tridentata*).

This is not the *Sp. granulatus* of Caullery and Mesnil, a species in which the embryos are developed in the operculum.

Miss Bush (1905) observes that the title *S. granulatus* has been erroneously given to

¹ 'Edin. Philos. Journ.,' xii, p. 244.

² 'Zeitschr. f. wiss. Zool.,' Bd. xxxiv, p. 123, fig. 41.

several forms, *e.g.*, *S. granulatus*, Fabricius, 1780 = *violaceus*, Levinsen, 1883; *S. granulatus*, Montagu, 1807 = *sulcatus*, Adams, 1797, *S. granulatus*, Langerhans, 1880, and probably that of De St. Joseph, 1894, and *militaris*, Claparède, 1868; *S. granulatus*, Caullery and Mesnil, 1897 = *Sp. granulatus*, Moore, 1902 = triangular form of *Sp. quadrangularis*, Stimpson, 1853. She states that "the tubes of the adult¹ are sinistral, with a deep groove on the top of the whorls, a large rounded carina on each side, the inner defining the small central cavity. In large specimens a shallower groove occurs on the side of the whorl, and a smaller carina along its lower edge. It is much longer and thicker than the dextral tricarinate *S. heterostrophus*, and must take the name *sulcatus*, Adams."

Percy Moore's² *Spirorbis granulata*, var. *tridentata*, Levinsen, is a species with three discs in front of the brood-sac in the operculum, and therefore differs from the present species.

Fauvel (1914) apparently follows Caullery and Mesnil in the discrimination of *S. granulatus*, his form also incubating in its operculum, and being found at the surface on sea-weeds in the Sargasso Sea, as well as on the shore at Grande Salvage.

A recent notice (1917) of *S. granulata*, L., by Folke Borg³ takes for granted that all authors refer to the type with the opercular brood-pouch, whereas comparatively few have dealt with this form. It may be, however, that such a differentiation is not specific, and the experience of *Filograna* would lead to caution in drawing conclusions without a more searching inquiry into the subject. So far as the published accounts and figures go there is marked divergence, amongst other features, in the operculum.

A *Spirorbis* is not uncommon on the under-surface of stones in Guernsey and Herm, in which, whilst the tube and other parts are indistinguishable, the collar-bristles do not show the marked distinction between the coarse serrations of the basal web and the fine serrations of the distal blade. Moreover, in certain examples the distal portion of the blade had coarser serrations than those usually seen in *S. granulatus*. The sickle-shaped bristles have the distal region broad and curved, with coarse serrations on the tapering part. The tube resembles that of *Spirorbis granulatus* in being coiled from right to left—that is, from the umbilicus or origin, and cannot be distinguished from it. It presents three ridges and two grooves on the free surface, and in some a slight degree of crenation of the ridges—a feature, however, better marked in *Sp. granulatus*. The aperture is circular, with the ends of two of the ridges projecting prominently above it. The operculum is comparatively thin and flat, with the external (calcareous) surface slightly hollowed out, and with a stalk which widens out superiorly to the full breadth of the disc. Moreover, the ova seem to be developed in the operculum.

A variety of *S. granulatus* comes from Cliff Sound, Scalloway, in which the branchiæ differ from the typical form at St. Andrews in the comparative stoutness of the filaments, and the diminution in the length of the distal pinnæ, so that the thick terminal process at the end of each filament becomes prominent, whereas in the examples from St. Andrews the long distal pinnæ obscure the slender terminal process. The operculum (Plate CXXII, fig. 8) differs little from that of the typical form, except that it tapers more abruptly inferiorly.

¹ On *Haliotis*, Guernsey, and limpet, Birterbury Bay, Ireland (Bush).

² 'Proc. Acad. Nat. Sc. Philad.,' p. 362.

³ 'Zool. Bidrag. Uppsala,' Bd. v, p. 28.

7. SPIRORBIS BOREALIS, *Daudin*, 1800. Plate CXXII, figs. 10 and 10*a*—operculum and branchia; Plate CXXXII, figs. 4—4*b*—bristles, 4*c*—tube, 4*d*—operculum; Plate CXXXIII, fig. 11—hook.

Specific Characters.—Collar typical, that is, open dorsally, but continuous ventrally and fusing with the lateral (alar) membrane of the first region. Branchiæ four¹ on each side, pale or dull yellow with a tinge of green, each filament having a short, slender and slightly tapered terminal process, and bearing from sixteen to twenty ciliated pinnæ, which are not quite opposite each other. Operculum saucer-shaped distally (peltate, terminating obliquely, Fleming), thin when viewed laterally; with a short, massive peduncle. Body 4 mm. long, widest in front, tapering to a somewhat broad tail having a rounded papilla on each side of the anus. Dark brown in front from the hue of the alimentary canal, reddish orange posteriorly. Anterior region has three bristled segments. The dorsal bristles of the first arise from a nearly cylindrical setigerous process, have less robust shafts than those of *Sp. granulatus*, and these dilate into a flattened process or shoulder distally, with a smooth lateral margin, whilst the distal edge has five rather coarse serrations (Levinsen says four large and two small), which increase in size from below upward, the striæ on the flattened process making them conspicuous. These are followed by the smooth edge of the “bite” as it rises to the somewhat “bellied” and finely tapered blade beyond, the edge of which is minutely serrated. Amongst these are some slender, simple, tapering bristles. The posterior bristles of the third series have broader sickle-shaped tips with long serrations so as to appear “feathery.” Anterior hooks borne on somewhat triangular plates narrower at one end than the other, the front edge with about forty serrations and the main fang blunt and bifid. The upper end of the hook slopes gently from the spinous edge and ends in an indefinite and membranous border, whilst from the base of the blunt main fang the slightly oblique outline proceeds a shorter distance than superiorly, and ends in the same indefinite membranous border. When the main fang is seen from the front, it is broad at the tip, narrower at the base and bifid. The posterior hooks are considerably smaller, and the backward curvature of the upper (anterior) serrated border makes a rounded end instead of an acute angle superiorly. The outlines of the base and of the posterior border join the indefinite margin, as in the anterior hooks. Hermaphrodite; eggs in the two anterior segments of the abdomen, sperms in segments behind. Ova in strings, one, two or three in a row in the tube. Tubes abundant on Fuci, sinistral shaped like the shell of a *Nautilus*, with a deep umbilicus on the free surface, the main mass being formed by the last coil, which shows transverse wrinkles of growth and less evident longitudinal striæ, and is slightly bevelled. Aperture circular, though a process of the tube projects beyond it on the surface of the seaweed.

SYNONYMS.

1685. *Vermiculus exiguus albus nautiloides*, Lister. Hist., pl. 553, fig. 5 (*fide auct.*).
 1699–1717. *Planorbis minimus*, Petiver. Gazophyl. Nat., tab. xxxv, fig. 8.
 1739. *Serpula spirorbis*, Plancus. Conch., Tab. i, fig. 8.
 1746. „ „ Linnæus. Fauna Suec., p. 535.

¹ Fleming says the branchiæ are six in number.

1747. *Serpula spirorbis* (*partim*), Linn. It. Westgothi, edit. Germ., p. 198.
 1758. „ „ Linnæus. Syt. Nat., x, p. 787.
 1767. „ „ idem. Syst. Nat., xii, p. 1265.
 1769. *Tubulus parvus* (*partim*), Martini. Conch., i, fig. 21, A, B.
 „ *Serpula polita*, Bolt. Verz., p. 49, No. 889.
 1770. „ *spirorbis*, Ström. Phys. og occon. beskr., i, p. 195, 1 (*fide auct.*).
 „ „ „ Gianni. Adr., 2, tab. i, fig. 8 (*fide auct.*).
 1776. „ „ O. F. Müller. Zool. Danic. Prod., p. 236, No. 2855.
 1777. „ „ Pennant. Brit. Zool., p. 145, pl. xci, fig. 155.
 1780. „ „ Fabricius. Faun. Grœnl., p. 377.
 1786. „ *spirillum*, Pallas. Nova Act. Petrop., p. 23, pl. v, fig. 21.
 1788. „ *spirorbis*, Da Costa. Brit. Conch., p. 22, taf. ii, fig. 11.
 „ „ „ Gualtieri. Test., t. x, fig. O.
 1789. „ „ O. F. Müller. Zool. Danic., iii, p. 3, Tab. lxxxvi, figs. 1—6.
 1799. „ „ Donovan. Brit. Shells, pl. ix, figs. 1, 2.
 1800. *Spirorbis borealis*, Daudin. Rec., p. 38.
 1803. *Serpula spirorbis*, Montagu. Test., p. 498.
 1806. „ *nautiloides*, Turton's Linn., iv, p. 603.
 „ „ *spirorbis*, idem. Ibid., p. 604.
 1807. „ „ Maton and Rackett. Linn. Trans., viii, p. 241.
 „ „ „ Brookes. Introd., p. 142, taf. ix, fig. 134.
 1812. „ „ Gmelin. Syst. Nat., p. 3740.
 1817. „ „ Dillwyn. Cat., p. 1073.
 „ *Vermicularia carinata*, Schumacher. Essai Hab. Test., p. 262 (*fide auct.*).
 1818. *Spirorbis nautiloides*, Lamarck. Syst., t. v, p. 359.
 „ „ „ idem. Edit. 2, v, p. 613.
 1820. *Serpula spirorbis*, Savigny. Syst. Annel., p. 74.
 „ *Spirorbis communis*, Fleming. Edinb. Encycl., vol. vii, p. 68.
 1825. *Serpula spirorbis*, Wood. Index, p. 185, Tab. xxxviii, fig. 8.
 „ *Spirorbis communis*, Fleming. Edin. Philos. Journ., xii, p. 245.
 1826. „ *nautiloides*, Risso. Hist. Europ. Merid., t. iv, p. 408.
 1827. „ *borealis*, Blainville. Dict. Sc. Nat., t. l, p. 301, pl. ii, fig. 2.
 „ ? „ *reversus*, Brown. Illust. Conch., pl. i, fig. 52.
 1828. *Serpula nautiloides*, De Blainville. Dict. Sc. Nat., t. lvii, p. 429, pl. i, fig. 2.
 1830. *Spirorbis communis*, Bosc. Vers., vol. i (2nd edit.), p. 216.
 „ *Serpula spirorbis*, Cuvier. Règne Anim., éd. 3, t. iii, pl. iii, fig. 1 (copy).
 „ *Spirorbis nautiloides*, Chenu, iii, pl. i, fig. 1 ? (animal).
 1836. „ „ Cuvier. Règne Anim., xiii (Griffiths' Trans.), Tab. viii, fig. 6.
 „ „ *reversus*, Templeton. Loudon's Mag. Nat. Hist., ix, p. 233.
 1838. *Serpula spirorbis*, Chenu. Conch., ix, tab. cxvi, fig. 999.
 „ Chenu, var. β , *reversa* (*T. discoidea*, *striata*, *marginata*).
 „ *Serpula baltica*, Wood. Gen. Conch. (ex Chenu).
 „ *Spirorbis* „ Sp. de Wood. Chenu, iii, p. 2, pl. ii, fig. 12.
 1840. „ *nautiloides*, Grube. Actin. Echin. u. Würmer, p. 65.
 1841. „ „ Gould. Massach., p. 9, fig. 3.
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Habitat.—Abundant on the Fuci in tide-pools and on the rocks between tide-marks, as well as on Laminariæ, St. Andrews (E. M.), and in similar places on Fuci and Laminariæ all round the British shores. Large examples also occasionally occur on stones in rock-pools, St. Andrews. Small specimens are found on dwarfed Fuci under stones in tide-pools in Guernsey and Herm. Shetland, on limpet; Torquay (Elwes); Langland Bay, Weymouth (J. G. J.); Plymouth (Allen); Firth of Forth (Leslie and Herdman, Cunningham and Ramage); Howth, Dublin and West Coast of Ireland (Southern).

Elsewhere it has been met with in Greenland (Michaelson, Ditlevsen); Finmark (Norman), off Norway, 300 fms. (Sars); shores of France (De Quatrefages, De St. Joseph, who states that it is rare, on stones); Shores of Cantabria (Rioja); Atlantic Coast, U.S.A. (Verrill, Webster and Benedict); Spitzbergen (Fauvel); Falkland Islands (Pratt); Canada (Whiteaves).

The collar is open as usual in the mid-dorsal line, but continuous ventrally, and it joins the alar membrane of the anterior setigerous region, which De St. Joseph has occasionally found of a bluish tint. The membrane passes ventrally behind the last bristle-tuft and fuses with that of the opposite side. At the base of the branchiæ are two minute eyes on the dorsum.

The branchiæ and anterior region are pale; the stomach forms a dark opaque part, whilst the posterior region is marked by bands of reddish pigment-granules in each segment, the tip of the tail being pale. Beneath the cuticle and hypoderm of the branchial filaments is a layer of closely arranged parallel bars, apparently of a chordoid nature, which may act as a skeleton for them. It becomes thinner at the terminal process, which at the tip is slightly bulbous, with a special arrangement of cells, somewhat after the manner of *Filograna*, but on a smaller scale and less distinct. Similar chordoid tissue of a modified kind also occurs in the pinnules, forming wider blocks; yet this aspect may be due to the contraction of the hypodermic tissue, though this is unlikely, since squares are seen on each side of the central cavity in life and when fully extended. An afferent and an efferent vessel pertain to each branchial filament, and the greenish blood seems to tinge the pinnules, which are richly ciliated.

The branchiæ (Plate CXXII, fig. 10a) are four on each side, each filament having a short, slender, and slightly tapered terminal process, and bearing from sixteen to twenty pairs of rather long, ciliated and nearly cylindrical pinnæ, which do not arise quite opposite each other. Their colour is dull yellow, with a tinge of green from the blood-vessels. They are sensitive organs, receding with a jerk into the tube on being touched.

The operculum (Plate CXXII, fig. 10 and Plate CXXXII, fig. 4*d*), derived from the first left branchia, is saucer-shaped, with a massive peduncle, is calcareous, and often infested by Diatoms and other structures. De St. Joseph found *Cothurnia maritima* growing on the operculum, and reproducing by fissiparity.

The *body* is dark brown in front from the alimentary canal, reddish orange posteriorly and 3 to 4 mm. in length. The pigment is arranged in irregular granular masses. The anterior region has three bristled segments, the first or collar-series having characteristic tips. The first part of the posterior region of the body is not segmented, though ciliated, the total number of segments in the region being eighteen to thirty-two, and terminated by the anus with a rounded papilla on each side. Each segment has two geniculate bristles. The segmentation of the posterior region of this species is better marked than in *S. granulatus*. In the first segment are two granular excretory organs from which ciliated canals join to form a single duct opening at the base of the branchiæ.

De St. Joseph describes the alimentary apparatus as composed of an œsophagus in the anterior region, a large brown cylindrical stomach immediately behind, followed by a sinuous intestine. He found spicules of sponges, diatoms, amongst others *Sphenosira catena*, in the stomach, all probably carried in by muddy currents. A blood-sinus encircles the canal with lateral branches and cæca in each segment. In some a pale green hue occurs below and at the sides of the stomach, and continues more faintly along the intestine to the vent. This apparently is due to the greenish blood of the sinus, since it disappears when a hernia of the stomach ensues. Lateral branches (segmental) leave the vessel at the gut. Gregarines similar to those of *S. granulatus* occur in the canal of this species, and they show the same active contractions and flexures.

The first or collar-bristles (Plate CXXXII, fig. 4) arise from a nearly cylindrical setigerous process, and differ from those of *Spirorbis granulatus*, L. Their shafts are less robust, though straight, and they also dilate distally into a flattened process at the commencement of the tip, but no fine serrations occur on the convex edge, the whole being occupied by two to five (Levensen shows seven) rather coarse serrations, which slightly increase in size in lateral view from below upward, the striæ on the flattened end of the shaft making them conspicuous. Then the smooth edge of the "bite" occurs as it rises to the somewhat bellied blade beyond, which, however, soon tapers to a delicate extremity, usually with a marked curvature. The bellied condition of the blade beyond the "bite" is a diagnostic feature in comparison with the bristles of *Sp. granulatus*, as also is the comparatively coarse edge, the serrations on which point upward and outward, so that a certain uniformity prevails. The basal part, moreover, is separated only by a slight step from the distal, and the serrations on it sometimes show a different angle. Such, however, diverges from the figure of the bristle given by De St. Joseph, in which the distal serrations are at right angles to the axis of the tip, a condition probably due to an indifferent microscope. The step of this bristle shows a distinct character when compared with the gap generally present in the collar-bristles. The shorter bristles are simple, tapering forms. The web at the base of the first series of bristles is seen to be double, and thus becomes homologous with the dilated spinous region at the distal end of the shaft in other forms. About the same number of simple tapering bristles occur with them in the tuft.

The bristles of the second setigerous process are simple straight forms, the tapered tips

of which are bent backward and provided with wings (Plate CXXXII, fig. 4a).¹ The four anterior bristles of the third series agree with the foregoing in the finely tapered, winged tips, but the posterior five have broader sickle-shaped tips, with a smooth wing at the base, and the forward curve of the sickle-like blade shows long serrations so that they are pectinate, the tip being finely attenuate (Plate CXXXII, fig. 4b). The serrations of these bristles are nearly at right angles to the long axis of the tip, and thus show a marked differentiation.

The anterior hooks occur in two rows in the segments bearing the second and third bristles, about twenty-three to fifty-five (De St. Joseph) in each. The hook forms a somewhat triangular, transparent plate (Plate CXXXIII, fig. 11), the anterior edge armed with about forty fine teeth. The main fang is blunt and projects little beyond the tip of the organ. De St. Joseph considers that it is larger than the others, but Miss Bush again observes that she has not seen this in any form. Transverse lines pass across the body of the hook from each spike or serration. When viewed from the front the blunt main fang is bifid. The posterior hooks are similar, but smaller, and the number of teeth in the row is considerably less (six to eighteen).

The sinistral tube is shaped like the shell of a *Nautilus* with a deep umbilicus on the free surface, and its main bulk is composed of the last coil which often hides the earlier coils, though in some these are distinct in the centre. The surface of the last coil is slightly bevelled and marked by transverse lines of growth. The aperture is circular, though a process of the tube projects beyond it on the surface of the seaweed. The tubes sometimes occur in rows, and on both surfaces of the *Fucus*. When two are near each other, and a third settles between them, the latter generally has an oblique position as it grows, so that the aperture may point more or less upward. Five coils are visible in some, the central being small, the outer much larger. De St. Joseph met with *Folliculina ampulla* in the interior of a tube, and the ova of *Automolos unipunctatus*, Graff (*Monocilis unipunctatus*, Cerst.); and Turbellarians are not uncommon in tubes from St. Andrews and Lochmaddy.

Reproduction.—*Spirorbis borealis* is hermaphrodite, the eggs being developed in the first two segments of the posterior region, and the sperms in the segments behind. The eggs are large and reddish brown, with a diameter of 0.18 mm., and form a simple, double or triple necklace in a transparent investment fixed to the tube. De St. Joseph observes that the embryos develop much as described by Willemoes-Suhm, and as already mentioned under *Sp. granulatus*.

Götte (1881) describes the development of *S. nautiloides*, which has a bilaterally symmetrical gastrula.

Cunningham and Ramage found it breeding in the beginning of June, the ova forming a cylindrical cord of "two or more" linear series in the tube. The embryos were well advanced before hatching.

Willemoes-Suhm² (as *S. nautiloides*) found the larvæ at Kiel in June, the adult being hermaphrodite, with the eggs in front and the sperms in the posterior segments. The ova are deposited in the tube. He points out that Pagenstecher describes the development of

¹ Løye figures the simple winged bristle with a serrated edge, Taf. xvi, fig. 11.

² 'Zeitschr. f. wiss. Zool.,' Bd. xxi, p. 394, Taf. xxxi, figs. 9, 10 and 13.

this form inside the operculum, but he found it different. The same form was noticed by Leschke¹ at Kiel.

At St. Andrews the ova are small at the beginning of March and are situated toward the termination of the stomach, some being in front and some behind the organ. The sperm-cells (for they are undeveloped) fill the body-cavity in the same region as well as extend to the tip of the tail. These cells are ovoid or elliptical, with a central streak. The enormous masses of the male elements are in contrast with the comparatively limited number of ova.

In Lister's 'Historiæ Conchiliarum' (1685) there is in the Index, after *Dentalium*, on Plate 547, fig. 4, *Serpula decussata*, and in Plate 548, fig. 1, *Serpula lumbricalis* and *S. anguina*. The relationship of these to known forms could not be determined.

Montagu (1803) noticed a variety of the tube with the mouth erect, and sometimes with one or two volutions projecting spirally upward. He termed the operculum the proboscis. Cosmovici (1880) observed that *Spirorbis communis* is hermaphrodite, as in the species described by Pagenstecher, the ovaries occurring in the middle of the body and the spermaries in the posterior region.

Spirorbis affinis, Levinsen,² looks not unlike *S. borealis*. He does not give a figure of the bristles, or furnish accurate data for identification.

In American literature *Spirorbis borealis* and *Sp. spirillum* appear to be often confused. Thus Miss Schively describes the eggs of *Sp. borealis* as passing through the operculum, which has a moveable plate of tissue, whilst *Sp. spirillum* has an opercular brood-pouch. As Miss Bush observes, she probably in the latter instances refers to *Sp. pagenstecheri*, yet the synonymy of the American Serpulids and Sabellids is puzzling, and some of the new species may yet be linked on to the old.

Caullery and Mesnil (1897) consider that the *Circeis armoricana* of De St. Joseph is only a variety of this species, somewhat larger, with more abdominal segments, and a smaller talon under the operculum, and that they had observed intermediate links between the two. Miss Pixell seems to have the same opinion. The *S. malardi*, Caullery and Mesnil, is a closely allied form—except for the spire (*Paralæospira*) and the presence of four setigerous segments. They observe that a certain amount of polymorphism characterises both tube and operculum; those examples which are fixed to stones have generally a smaller umbilicus and are less regularly spiral than those on algæ. The operculum on those attached to stones has the talon (basal division) separated by a constriction and often bifid. They found nine branchiæ in the young, ten in the old. Their figures of the collar and the sickle-shaped bristles are good.

Wollebæk's figure (6) shows a smooth terminal blade, and the absence of minute details indicates that the kind of plate in the memoir is perhaps not well adapted for such illustrations.

Loye³ (1908) found Diatoms and other algæ and *débris* imbedded in the calcareous matter of the tube. He gives an account of the general anatomy of this species, with the physiology of the parts, in the several regions, viz., the cephalic, the thoracic, the next without bristles, and, lastly, the abdominal region. He found definite transverse muscles only in the thoracic

¹ 'Wiss. Meeresuntersuch.,' Bd. v, p. 128, 1902.

² 'Greenland,' pp. 200 and 207, Tab. iii, fig. 7.

³ "Die Anat. von *S. borealis*," Spengel's 'Zool. Jahrb.,' Bd. xxvi, pp. 305—354, Taf. xvi—xviii.

division. The thoracic excretory organs correspond with those of other Serpulids, viz., a lateral funnel on each side, then an angular bend into the canal, which meets its neighbour of the opposite side, and terminates in the single duct opening dorsally. The pale greenish blood is sent from a ring behind the ganglia to the branchiæ, the anterior end of the sinus behind it functioning as a contractile heart, which sends blood not only to the ring, but into the ventral trunk. In the abdominal region he shows ring-vessels in each segment to the tip of the tail. The nervous system has two chief cephalic ganglia, the two main trunks with enlargements in front, and connectives behind, also with ganglionic enlargements. A main feature of the paper is the consideration of the asymmetry of the body and most of its organs, even the bristles and hooks of the two sides sharing in the irregularity. He endeavours to explain the action of the asymmetrical muscles by ingenious diagrams in text and plate.

Fauvel (1914) holds that his form is not that of Montagu, Fleming or Pagenstecher. The facts that the tube is sinistral, that the first bristles have no gap at the base of the tip, and that the eggs are developed in the tube, would appear, amongst other things, to show that it is the common form.

Southern (1914) considers there are two forms of this species, viz., those with smooth tubes on seaweeds, etc., and those with ridged tubes on rocks. He holds it is the *S. borealis* of De St. Joseph.

B. Incubation in Operculum.

8. SPIRORBIS MILITARIS, *Claparède*, 1868. Plate CXXII, fig. 12—operculum; Plate CXXXII, figs. 7 and 7b—bristles; Plate CXXXVIII, fig. 16—anterior hook.

Specific Characters.—Cephalic collar typical. Branchiæ reddish, have comparatively thick filaments, and the terminal process is long and tapered. Operculum helmet-shaped, with denticulated ridges and accessory spines. The ova are developed in its cavity. Body typical in outline, and of a deep or pale reddish hue. The first bristles are characterised by their large size, yellow colour, and the coarseness of the serrations on the terminal blade, which has a distinct gap above the web at the base. The anterior hooks have about twenty sharp serrations along the anterior edge, and their outline is more acutely triangular than usual, with boldly marked striæ sloping downward and backward, each tooth parallel to the posterior border and to each other. The terminal process or main fang is comparatively small, with a slight bay behind it. Tube smooth, comparatively large, with a rounded aperture, which projects from the surface of the *Lithothamnion*, in which the rest is immersed.

Claparède (1868) constituted the genus *Pileolaria* for this species, the characters of which were the presence of an ordinary thoracic membrane, few branchiæ, a calcareous, compressed operculum with denticulations, and a coiled calcareous tube. It does not appear to be necessary to resort to a new genus, and such was the opinion of Caullery and Mesnil.

SYNONYMS.

1833. *Serpula spirorbis*, Scacchi. Catal. conchyl. reg. Neap., p. 19 (*vide auct.*).

1868. *Pileolaria militaris*, Claparède. Annél. Nap., p. 444, pl. xvi, fig. 5.

” ” ” Claparède and Mecznirow. Zeitschr. f. wiss. Zool., Bd. xix, p. 200, Taf. xvi, fig. 3.

1875. *Pileolaria militaris*, Panceri. Atti Soc. Ital., vol. xviii, p. 535.
 1880. ? *Spirorbis granulatus*, Langerhans. Zeitschr. f. wiss. Zool., Bd. xxxiv, p. 123, pl. v, fig. 41.
 1883. *Pileolaria militaris*, Salensky. Arch. de. Biol., t. iv.
 1885. „ „ Carus. Fauna Medit., i, p. 280.
 1893. „ „ Lo Bianco. Atti R. Accad. Sc. Nap., vol. v, no. 11, p. 92.
 1897. *Spirorbis* „ Caullery and Mesnil. Bullet. Sc. France et Belg., t. xxx, p. 215, pl. x, fig. 25.
 1909. „ „ Fauvel. Bull. Inst. Oceanogr., No. 142, p. 55.
 „ „ „ var. Sterzinger. Sitzungsber. k. Akad. wiss. Wien, Bd. cxviii, p. 1451, text-figs. 15 and 16, Taf. ii, fig. 26.
 „ *Pileolaria* „ Lo Bianco. Mitt. Zool. Stat. Neap., Bd. xix, p. 583.

Habitat.—On the surfaces of stones and rocks encrusted with *Lithothamnion* between tide-marks at St. Peter Port and other parts of Guernsey, and under similar conditions at Herm. Abroad it has been found at Naples (Claparède); shores of France (Caullery and Mesnil). The tubes are encrusted, as in the Channel Islands, with calcareous algæ. Madeira (Langerhans); Monaco (Fauvel); Suez (Sterzinger).

This species, which was probably included by Scacchi as *Serpula spirorbis*, in his 'Catalogue of the Shells of Naples,' has been well known since Claparède described it as *Pileolaria militaris* in his volume on the Annelids of Naples. It is a southern type, and, so far as known, has hitherto been confined in the British area to the Channel Islands, though Caullery and Mesnil found it not infrequent on the shores of France, and Langerhans mentions a form (his *Spirorbis granulatus*, L.), which these authors consider to be only a variety from Madeira. It is rarely met with in the Channel Islands.

The operculum (Plate CXXII, fig. 12) is comparatively large, helmet-shaped, and ornamented with denticulated ridges and accessory processes. The cavity of the helmet performs the function of a brood-pouch, and in those captured in July and August was filled with large eggs and embryos, the breeding season at Naples being somewhat earlier, viz., in June and July. It differs from such as *Spirorbis Pagenstecheri*, De Quatrefages, in so far as the opercular helmet is ready to receive the ova without further addition or alteration. Its specific name has reference to the helmet-like condition of the operculum.

The branchiæ have comparatively thick filaments, which end in a long and slender process.

The body is typical in outline, has a deep reddish hue, and the same colour tinges the branchiæ, the collar and the alar membrane (Caullery and Mesnil). Anterior region of three bristled segments.

The first or collar-bristles (Plate CXXXII, fig. 7) are characterised by their size, the coarseness of their serrations, the presence of a distinct gap, and their yellow colour. Moreover they are boldly curved at the tip so as almost to resemble geniculate bristles. They are accompanied by a series of simple bristles, which are widest, though they do not quite reach the size of the former bristles, at the base and gradually diminish to a delicate hair-like tip. The next bristle-tuft has capillary bristles, with finely serrated wings (Plate CXXXII, fig. 7a), the shaft in each being nearly cylindrical or very slightly tapered; whilst the third has sickle-shaped forms (Plate CXXXII, fig. 7b).

The anterior hooks (Plate CXXXVIII, fig. 16) are acutely triangular, with a bold series

of teeth, about twenty in number, along the anterior edge, and these stand out prominently, sloping downward and outward. The main fang or terminal process is comparatively small, and it does not show the bifid condition distinctly. A slight bay occurs behind it. The posterior hooks are much smaller, but have a similar outline.

Reproduction.—The species is hermaphrodite, the ova occurring anteriorly and the sperms posteriorly. Those procured in Guernsey and Herm in July and August had large ova and embryos in the opercular brood-pouch. Lo Bianco found the same in June and July at Naples. Several stages of the larva of this form are shown by Claparède and Meczniow¹ (1868), and they are parallel with those of their *S. Pagenstecheri*. The blunt cephalic lobe of the youngest stage has two eyes with lenses, and two without them, separate masses of orange yolk in the body, a prototroch, a tuft of cilia anteriorly and posteriorly, and an anterior or thoracic membrane. The subsequent stages show a double process on the snout, and the characteristic bristles of the anterior region.

Claparède (1868) gave an account of this form with figures of the operculum and bristles from Neapolitan examples, placing it under a new genus, *Pileolaria*, but, as has already been shown, it falls naturally under the old genus *Spirorbis*. He recognised its hermaphrodite condition, as well as found the larvæ at various stages inside the helmet-like operculum.

Salensky² studied the development of *Sp. militaris* to the period of fixation and the formation of the operculum, which at first is concave instead of convex, and, as Caullery and Mesnil state, thus falls into line with the usual condition of the operculum in the group.

The exact relationship of this form with *Spirorbis cornu-arietis* (Philippi) of Marion and Bobretzky, and as mentioned by Caullery and Mesnil, is still uncertain, for the latter authors state that in the absence of the operculum it is impossible to distinguish the one from the other. It is therefore a question if the operculum alone be relied on. Caullery and Mesnil unite the *Sp. granulatus* of Langerhans with this form.

Irene Sterzinger³ (1909), in a careful and excellently illustrated account of a collection from Suez, describes a variety of this species with smaller processes on the summit of the operculum. The gap at the base of the tip of the collar-bristles is marked.

Two forms, familiar in the literature of the subject, are not entered here, viz., *Spirorbis heterostrophus*, Montagu, and *Spirorbis carinatus*, Montagu, since both are probably included in the forms dealt with, and, at any rate, the uncertainty can only be removed by a careful re-examination of fresh animals. Miss Bush and others do not seem to have formed a definite opinion about either. The first is *Spirorbis heterostrophus*, Montagu, 1803.

At first sight the dried tube resembles that of *S. granulatus*, but it is dextral, whereas that of the form mentioned is sinistral. The tube (Plate CXXXIII, fig. 5, from an English example) is coiled from left to right, and has a deep groove on the summit, and two ridges.

¹ 'Zeitschr. f. wiss. Zool.,' Bd. xix, p. 200, Taf. xvi, figs. 3—3 E.

² 'Arch. Biol.,' t. iv, p. 143, 1883.

³ 'Sitzungsber. k. Akad. Wiss. Wien.,' Bd. cxviii, p. 1451, etc.

Occasionally the aperture is turned upward. All the specimens are small and of uniform size.

Montagu (1803)¹ describes it as having "a strong, spiral shell, of a dirty white colour, with two or three reverse volutions placed laterally, furnished with three longitudinal ridges, one along the back, and another on each side, roughly wrinkled transversely; the base is flat and somewhat spreading; aperture orbicular, and invariably placed opposite the sun's apparent motion. Diameter not a line." He found it on oyster and other shells and on algæ. It is readily distinguished from *S. spirorbis* by the longitudinal ridges, and by the contrary turn of the volutions. Under slate-stones at Kingsbridge Bay in great abundance (covering the surface) between tide-marks. He thought the sub-saline quality of the water so far up this inlet, at ebb tides, not congenial to other forms. Montagu,² again, found *Spirorbis carinatus* common on *Arca pilosa* and *Pinna ingeus* on the south coast, and described it as having "a dull, opaque, white, spiral shell; the outer whorl rising into a carinated ridge on the top; the middle concave, sometimes pervious; the interior volutions inconspicuous; base a little spreading; aperture round. Size about half that of *S. spirorbis*, from which it is readily distinguished by the angulated shape of the exterior whorl, which is formed like *S. triquetra*, but always regularly spiral." Fleming³ observes that the shell has two whorls, a narrow base and nearly vertical sides. Upper surface almost flat or slightly concave, with a central cavity surrounded by a sharp, rather elevated margin. The outer margin is nearly rectangular with a sharp edge. Outer surface is transversely wrinkled, the whole less regular than the preceding (*S. granulatus*), with the aperture more ascending." His examples appear to have come from Shetland. Mörch, again, states that the tube is regularly spiral, with the outer whorl rising into a carinated ridge on the top. It is about half the size of *S. spirorbis*, and a little spreading at the base. Miss Bush⁴ thinks Fleming's form approaches *S. quadrangularis*, Stimpson, adding—"but it is not improbable both species occur on the English coast." She alludes to two forms, one dextral from Guernsey and Ireland, the other sinistral from England, but comes to no definite conclusion.

The tubes of *S. carinatus* (Plate CXXXIII, fig. 6) from Exmouth (W. Cocks, 1822) are small and have a reversed coil to that of *S. heterostrophus*, Mont. The inner side of the last whorl is broadly grooved, whilst a ridge runs along the top of the coil. The aperture is round, and the centre of the coil is either filled up by the early whorls or is blank—forming a large umbilicus. It resembles a young *S. granulatus*, but only one groove is distinct; whereas Levinsen shows two ridges in his figure. The collar-bristles present numerous small serrations, only the upper being larger, on the rather long triangular base, followed by a gap and then the finely serrated tapering blade. The whole, therefore, approaches the bristle of *S. granulatus*.

In the British Museum⁵ another example of the second form, labelled *S. carinatus*, Mont., comes from Greenland, attached to a Polyzoön like a large *Salicornaria*, and forwarded

¹ 'Test. Brit.,' vol. ii, p. 503.

² 'Test. Brit.,' vol. ii, p. 502, 1803.

³ 'Edin. Philos. Journ.,' vol. xii, p. 244.

⁴ 'Tubicolous Annelids from the Pacific,' p. 249.

⁵ I am indebted to Sir Sidney Harmer, Mr. Tate Regan and Dr. Calman for their courteous aid in the examination of this and other specimens in the collection.

from the Copenhagen Museum. The annelid has branchiæ with long, tapering terminal processes, a rounded, calcareous operculum and three pairs of thoracic bristles. The collar-bristles have a basal web, with moderately distinct serrations, and a tapering blade with minute serrations. These bristles thus approach those of *Spirorbis granulatus* and *S. borealis*. The third series appeared to have sickle-shaped bristles. The tube has three sharp ridges and two grooves, the ridges only differing from those of *S. granulatus* in their thin, spinous edges, and the median one in some becomes deeper at the aperture so that it forms a conspicuous keel, with a small sharp point over the circular aperture.

ADDITIONS TO THE BRITISH MARINE POLYCHÆTA SINCE THE PUBLICATION OF THE MONOGRAPH.

FAMILY EUPHROSYNIDÆ.

Post-Larval *Euphrosyne*.

Procured by Mr. Chadwick in a tow-net in Port Erin Bay, December, 1905.

Anteriorly in the microscopic preparation the head consists of a somewhat shield-shaped lobe, broad and slightly dimpled in front, narrower behind, and with a more deeply stained clavate band along each side—at the anterior end of which is a minute dark eye. This shield-shaped region is minutely streaked and dotted, apparently from the minute cells and granules taking in the stain. On each side of this area is a tentacle, the base of which is enlarged and the tip filiform and tapering.

The entire *body* has a more or less circular outline, and the four pairs of feet radiate outward characteristically, the anterior pair being wide apart, and directed almost straight outward, or with a slight obliquity forward, whilst the last pair is somewhat smaller, and more nearly in a transverse line. Each foot consists of a setigerous process tapered toward the tip, so that it resembles a long cone with a tuft of translucent, slightly curved, simple bristles issuing from it in a fan-like manner. Each bristle has a translucent straight shaft, the curved region at the tip being finely spinous on its convex side. Amongst these is a shorter, stouter form, also curved at the tip, but smooth. Shorter and more slender bristles apparently represent the dorsal series, and, in all, these form a group at the tentacle, their tips, which are finely serrated, curving inward at the side of the head. A similar tuft occurs on the dorsum of each foot, though in the smallest (youngest) they are not visible on the two posterior feet. The curvature of these bristles may be partly due to preservation. The alimentary canal seems to go straight backward to the vent, the last portion, occupying a little less than a third of the length of the body, being more deeply stained. A median fissure separates two minute and somewhat ovoid lobes between the bases of the posterior feet.

So far as can be observed, this would seem to be the pelagic young of *Euphrosyne*, probably of *E. foliosa*, the common species of the more southern waters. The general outline,

the cephalic lobes, so largely developed in the young, the ovoid anal processes, and the nature of the feet and bristles all point to this conclusion. Such young examples seem to be rare, and I am indebted to Mr. Chadwick's¹ courtesy for the slide containing the examples.

FAMILY PALMYRIDÆ.
(*Chrysopetalea*, Ehlers.)

Head rounded and short, with eyes, tentacles, and tentacular cirri; segments with massive appendages, the paleæ of which cover the dorsum. Alimentary canal akin to that of the Euphrosynidæ, Aphroditidæ and Polynoidæ.

Genus CHRY SOPETALUM, Ehlers, 1864.

Head with three tentacles and two palpi. Body with few segments, short and broad; first segment with four tentacular cirri; dorsal process with a spine bears a fan of paleæ in each segment; foot with a dorsal cirrus, a setigerous process with jointed bristles.

CHRY SOPETALUM DEBILE, Grube, 1855. Plate CXXXVI, fig. 1—dorsal bristle.

Specific Characters.—Head transversely oval, eyes two, small; tentacles five, the two inferior much larger, with a basal articulation, the three upper filiform, enlarging at the base, the outer the length of the tentacular cirri. Body oblong, whitish, segments about twenty-two and nearly equal, 2·5 lines long, and with a total breadth of half a line. Foot with a short, straight spine; dorsal cirri filiform, enlarged at the basal articulation. Dorsal division of the foot with bristles like paleæ, slightly curved, spathulate, one margin straight, the other curved, the tip with about eighteen crenulations; ventral division with a tuft of straight compound bristles, spinous and transversely striated. They do not reach the tip of the setigerous process.

SYNONYMS.

1855. *Palmyra debilis*, Grube. Arch. f. Naturges., Bd. xxi, p. 90.
 1864. „ (*Palmyropsis*) *Evelinæ*, Claparède. Glanures, p. 126, pl. viii, fig. 6.
 „ *Palmyrides portus-veneris*, idem. Ibid., p. 123, pl. viii, fig. 5.
 „ *Chrysopetalum fragile*, Ehlers. Borstenw., p. 81, Taf. ii, figs. 3—9.
 1865. *Chrysopetalum debile*, De Quatrefages. Annel., t. i, p. 296.
 „ „ *fragile*, idem. Ibid.
 1880. „ „ and *cæcum*, Langerhans. Zeitschr. f. wiss. Zool., Bd. xxxiii, p. 278.
 1897. ? „ *occidentale*, Johnson. Proc. Califor. Acad. Sc., ser. 9, i, p. 161.
 1906. „ *debile*, De St. Joseph. Ann. Sc. nat., 9^e sér., t. iii, p. 146, etc.
 1913. „ „ Fauvel. Bull. l'Institut. Oceanogr., No. 270, p. 35.
 1914. „ „ Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 60.
 „ „ „ Fauvel. Camp. Sc., p. 95.
 1921. „ „ McIntosh. Ann. Nat. Hist., ser. 9, vol. viii, p. 291.

¹ Vide 'Ann. Nat. Hist.,' ser. 9, vol. viii, p. 290.

Habitat.—A single example of *Chrysopetalum debile*, of the Family Palmyridæ, was dredged on a bottom of sand and shells in Clew Bay (Southern).

Distribution.—Villafranca, Mediterranean (Grube); Madeira (Langerhans); ? California (Johnson).

The occurrence of a representative of a genus, characteristic of the warmer seas, on the West Coast of Ireland, indicates the richness of this remarkable region, and the possibility of further interesting discoveries yet in store for the Marine zoologist. In the description of *Palmyra aurifera*, Savigny, in the "Challenger" Annelids *Chrysopetalum debile* is alluded to in connection with the presence of scales.¹

FAMILY POLYNOIDÆ.

Genus EUCRANTA, *Malmgren*, 1865.

Lateral tentacles springing from each side of the base of the median, the three occupying the whole breadth of the region. Palpi subulate, minutely papillose. Fifteen pairs of elytra, covering the dorsum with the exception of the ultimate segments, and occupying the feet—1, 3, 4, 6, 8 22, 25, 28, 31. Dorsal bristles forming a dense tuft which scarcely reaches the bases of the ventral bristles, each of the internal bristles somewhat curved at the tip, and furnished with rows of spikes. Ventral bristles longer, in horizontal groups, the upper series longer and bifid (the secondary process being unusually long), all with rows of spikes.

EUCRANTA VILLOSA, *Malmgren*, 1865. Plate CXXXIV, figs. 2, 2a and 2b—bristles.

Specific Characters.—Cephalic lobe with two anterior peaks; eyes four—two near the base posteriorly, and two dorso-laterally anteriorly. Lateral tentacles not longer than the head, ciliated. Body elongate-oblong, flattened; bristled segments thirty-six to forty. Elytra obliquely ovate or sub-orbicular, with long cilia on the margin and scattered over the surface. Dorsal cirri. Ventral cirrus subulate, sparsely ciliated. Nephridial papilla cylindrical, elongate. Tentacular and anal cirri easily shed.

SYNONYMS.

1865. *Eucrante villosa*, Malmgren. Nord. Hafs. Annul., p. 80, Tab. x, fig. 9.
 1867. „ „ idem. Annul. Polych., p. 14.
 1873. „ „ Sars. Bidrag Christ. Fauna, p. 4 (sep. copy).
 1877. „ „ Marenzeller. Kaiserlich. Akad. Wiss. Wien., Bd. xxxv, p. 39.
 1879. „ „ Théel. Kongl. S. Vet. Akad. Handl., Bd. xvi, No. 3, p. 23.
 1882. *Polynoë villosa*, Hansen. Norske Nord.-Hav. Exped., p. 44.
 1889. *Harmothoë* (and *Eucranta*) *villosa*, Trauttsch. Arch. f. Naturges., Bd. lv, pp. 139 and 143.
 1911. „ *villosa*, Ditlevsen. Danmark Exped. Grønl., Annel., p. 416.
 1912. *Eucranta villosa*, Small. Ann. Nat. Hist., ser. 8, vol. x, p. 181, pl. vi, figs. 3—5.

¹ 'Rep. Annelida,' p. 55.

Habitat.—Dredged by the S. F. B. ship “Goldseeker” in the North Sea at $61^{\circ} 39' N.$, $4^{\circ} 45' W.$ at a depth of 620 m.

Abroad Lovén dredged it off the island of Koster in Swedish waters; between Spitzbergen and Nova Zembla (Marenzeller); Christiansund (Hansen, Trauttsch, Ditlevsen).

The head is produced anteriorly into two conico-rotund processes. The eyes are large, the larger anterior pair “well back on the head and close to its lateral edge” (Small), the posterior pair “laterally in front of the nuchal border.” (*idem*). The ciliated lateral tentacles are about the length of the head, and the median tentacle, which was first alluded to by Théel, is about twice the length of the head, its tip being remarkably slender, and covered with minute cilia. The subulate palpi have minute papillæ.

The *body* is elongate-oblong, flattened, and has thirty-six to forty segments. The scales are obliquely ovate or sub-orbicular, with a dense series of cilia on the exposed margin and on the surface. The tubercle mentioned by Malmgren as taking the place of the dorsal cirri in those segments devoid of scales could not be seen by W. Small. The ventral cirrus has sparse clavate cilia.

The feet are characterised by the conspicuous condition of the dorsal bristles, which W. Small found more prominent than indicated in Malmgren's figure, the bristles themselves more curved, and the spines on them became larger toward the tip (Plate CXXXIV, fig. 2). “The transverse rows of spines almost pass completely across the bristle, recalling the condition in *Evarne impar*. The inferior bristles are more curved, more slender, and have longer spines than the superior” (Small). A similar modification of the terminal region of the superior bristles is seen in *Eupolynoë occidentalis*, McL., and in *E. anticostiensis*, McL., from the St. Lawrence, Canada.

The ventral series is distinguished by the bifid condition of the longer and more slender upper bristles, arising from a modification of the secondary process and tip generally (Plate CXXXIV, fig. 2a). “The lateral spines are large and slightly recurved, and are almost equalled in length by the transverse rows of spines. The spines decrease in number and size toward the tip, and the bifid portion of the bristle is entirely naked, with a slight swelling immediately below the bifurcation” (Small). The inferior bristles (Plate CXXXIV, fig. 2b) conform to the type seen in *Eunoa*, the tip being entire, and, as pointed out by W. Small, the spines are confined to the lower half of the tip, the distal region being smooth.

This species was discriminated by Mr. Wm. Small, B.Sc., from an imperfect example procured by the S. F. B. ship “Goldseeker” in the North Sea, and has not been found in the inshore waters of Britain.¹

Genus LEPIDASTHENIA, *Malmgren*, 1867.

The genus was established by Malmgren for a species found by Grube and Heller in the Adriatic, and therefore a strictly Southern form. It is characterised by the small head bearing four eyes and covered by the first pair of scales, a median and two lateral tentacles, all smooth. Palpi smooth and of moderate length. Tentacular cirri, long, filiform and smooth. Body of considerable length, sublinear, flattened; scales comparatively small,

¹ By the courtesy of Prof. D'Arcy Thompson, this collection of Polychæts was forwarded for investigation by W. Small and Jas. Watson Pryde.

leaving the centre of the dorsum bare, occurring on segments 1, 3, 4, 6, 8 . . . 20, 22, 25, 28 . . . 79, 82, etc. They are smooth, pellucid, iridescent, brownish, with a stellate arrangement of the nerves, and decreasing in size posteriorly. The foot is bifid at the tip, a long, pointed papilla being in front, and a less acute process behind. Dorsal division represented only by a papilla with an included spine and a cirrus internally. Ventral division bearing chiefly bifid spinous bristles, the upper series being either more robust or with longer tips. Ventral cirrus smooth, but a row of papillæ may occur between it and the nephridial aperture. Two anal cirri.

LEPIDASTHENIA ARGUS, *Hodgson*, 1900. Plate CXXXIV, figs. 1 and 1g'—body, proboscis, scale and bristles.

Specific Characters.—Cephalic region with brown pigment posteriorly. Median tentacle rather long, enlarged near the filiform tip; lateral tentacles more slender and the swelling indistinct; tentacular cirri similar to the lateral tentacles; all are smooth and have a dark pigment-band at the distal part of the enlargement, which is marked by a belt of opaque white. Body elongate ($8\frac{1}{2}$ inches) and with upwards of 200 segments, little tapered anteriorly, but more distinctly so posteriorly, where a cirrus occurs on each side of the anus. Proboscis firm, cylindrical, with about twelve papillæ on each margin, and two horny teeth above and below, alternating when locked. Colour of various shades of brown, sometimes with a purplish hue; a transverse bar of dark brown at each segment-junction. The cirrus-bearing segments have a diffuse patch of the same pigment. Ventral surface pale with a median line of red. Scales sub-circular or in a few reniform, smooth on margin and surface, with a fan-shaped patch of brown pigment, the narrow end anterior, whilst near the posterior margin is a crescentic band of opaque white.

Feet with vertically bifid setigerous processes, the tip of the anterior being the longer and more distinctly conical. Dorsally is either a cirrus, which is smooth and filiform without enlargement below the tip, or a scale-process, whilst ventrally is a short cirrus. The dorsal division is represented by a distinct papilla into which the spine goes, and in some (posterior) by a few simple bristles. Ventral bristles in three groups, viz. an upper with long, slender shafts and elongated spinous tips, a median and more numerous group with stouter shafts and shorter tips, and an inferior series more slender than the median and with short spinous tips. The tips of the bristles are in most bifid.

SYNONYMS.

1900. *Lepidasthenia argus*, Hodgson. Journ. M. B. A., vol. vi, p. 250.
 1915. „ „ Ibid., vol. x, p. 613.
 1921. „ „ McIntosh. Ann. Nat. Hist., ser. 9, vol. viii, p. 292.

Habitat.—Salcombe, in the tubes of *Amphitrite Edwardsi* (Todd); Plymouth (Hodgson).

The cephalic region (Plate CXXXIV, figs. 1 and 1a) is reddish, with a median longitudinal groove. The median tentacle is long, stout, enlarged near the filiform tip; lateral tentacles more slender and the swelling indistinct. Tentacular cirri similar to the lateral tentacles. All the foregoing are smooth with a dark band at the distal part of the enlarge-

ment, which has a belt of opaque white. The palpi are long and tapered, exceeding the tentacular cirri in length. Eyes 4, anterior pair wider apart and slightly larger than the posterior. The proboscis in extrusion is a firm, cylindrical organ, fully a centimetre in length, with a transverse slit at the tip guarded by about a dozen papillæ on each margin, most of them with pigmented patches. Two slightly curved horny jaws occur above and below, and when locked they are alternate. The basal region of the organ in extrusion is marked dorsally by two brown bands.

The *body* (Plate CXXXIV, fig. 1) is elongate ($8\frac{1}{2}$ inches), and with upwards of 200 segments, tapered a little anteriorly, and more distinctly posteriorly, where it terminates in an anus with two short cirri. In life the colour is a brown of varying degrees of intensity with a tendency to a purplish hue. The intervals between the segments have a transverse bar of dark brown, and the cirrus-bearing feet have a diffuse patch of the same pigment, scarcely perceptible on those carrying elytra. The ventral surface is nearly colourless except for a median longitudinal line of red.

The scales (Plate CXXXIV, fig. 1c) are sub-circular, or in a few reniform; surface and margin smooth. Each has a dark brown patch immediately behind the scar and spreading inward toward the posterior border, near which is a curved streak of opaque white. Arbor-escient nerve-twigs are spread over the entire elytron. One example, $8\frac{1}{2}$ inches long, had 67 elytra and 199 segments.

In the first foot the dorsal division is represented by a papilla to which the spine goes. The ventral division carries thirty or more bristles, which have slender shafts and elongated spinous tips, with, in some, traces of a cleft. The spinous border is directed ventrally. The ventral cirrus is long. In the typical foot (Plate CXXXIV, fig. 1a) the dorsal division may carry four or five long, slender and smooth bristles (Plate CXXXIV, fig. 1f). In the ventral division are three groups of bristles—an upper, with long, slender shafts and elongate spinous tips, a median of numerous stout bristles, with shorter tips (Plate CXXXIV, fig. 1), and a ventral series with still shorter tips. All the bristles, with the exception of the first two feet, are bifid. The segmental papillæ are very prominent in the posterior part of the body and the segmental organs are indicated in Plate CXXXIV, fig. 1. The dorsal cirri resemble the tentacular cirri and extend nearly to the tips of the bristles.

It is an interesting fact in the history of this genus that one species from the Antarctic Seas resides in a tube formed by the branches of a coral, the tough nature of the reticulated walls of the tube thus making an efficient protection for the elongated annelid. The twigs of the coral seem to adapt themselves to the tunnel of the worm.

FAMILY PISIONIDÆ, *Grube*.

Genus PRÆGERIA, *Southern*, 1914.

Pisionidæ with much reduced head; ventral cirrus of first setigerous segment elongate and functioning as a tentacular cirrus; dorsal cirrus of second setigerous segment globular, as on the following segments; genital papillæ absent; anterior feet with one, posterior feet with two, simple bristles.

PRÆGERIA REMOTA, *Southern*, 1914. Plate CXXXVIII, fig. 1—animal enlarged; Plate XXXIV, figs. 3, 3a and 3b—bristles.

Specific Characters.—Head fused with the anterior segments; brain with elongate lobes united in front and stretching into the fourth bristled segment. Behind the middle are two pairs of black eyes resting on the brain, the pair on each side being connate, the lenses pointing in opposite directions; two additional pigment-specks behind the middle of the brain. In front of the brain is a flattened four-sided lobe, probably representing the head, and surrounded on its anterior sides by the enlarged bases of the buccal feet, which are fused with the front of the head—except for a dorsal and a ventral groove. Each contains a large spine, swollen in the middle and dilated at the tip, where it is bevelled and may have a few spikes, and its inner end is near the base of the first bristled foot. The massive base ends dorsally in a tapering cirrus, and beneath it is a small flask-shaped cirrus. To the ventral surface of the buccal feet are attached a pair of long, slender cirri about three times as long as the dorsal buccal cirri, the bases of which are enclosed by conspicuous membranous sheath (homologues of the buccal cirri of the Polynoidæ, Ehlers, whereas Southern considers them homologous with the palps of the Polynoidæ). Mouth a transverse slit on the ventral surface, guarded behind by a crenulate lower lip. Body long and narrow (7—15 mm.), tapering a little toward the head, and more distinctly posteriorly; segments fifty-five or more. Colourless or flesh-coloured; those in the middle of the body almost as long as broad, with elongate feet. Anal segment button-shaped, with two long slender anal cirri. Proboscis eversible, with fourteen conical amber-coloured papillæ, the two lateral carrying in addition a small papilla on the outer margin. Each jaw is crescent-shaped, with irregular projections. It is followed by a muscular stomach occupying three to four segments. First setigerous foot with a slender and elongate ventral cirrus as in *Pisione*; dorsal cirrus of the second foot normal, that of *Pisione* being long and slender. The feet (*e.g.*, the fifth) have an elongate bifid setigerous lobe; dorsal and ventral cirri spherical, attached by narrow bases and with terminal papillæ carrying palpocils; two spines with curved tips, the upper representing the reduced dorsal division, besides four compound bristles and one simple. The compound have slightly curved shafts, bifid at the tip, the terminal piece pointed with a row of fine teeth. The dorsal bristle is thick, expanded and bevelled at the tip, which has a row of spines. About the tenth or twelfth foot a second simple bristle occurs beneath the dorsal, and it has a smooth tip. Genital papillæ absent. Immature ova found in May.

SYNONYMS.

1914. *Prægeria remota*, Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 61, pls. vii—viii, figs. 15A-K.
 1921. „ „ McIntosh. Ann. Nat. Hist., ser. 9, vol. viii, p. 293.

Habitat.—Dredged in Dingle Bay, in 10 to 20 fathoms, on a bottom of sand and shells or gravel; those from Clew Bay were captured in a fine-meshed tow-net attached to the dredge in 24 to 27 fathoms (Southern).

Nothing can be added to the excellent description and figures of Southern. The stout simple dorsal bristle has a characteristic spur or heel, besides the spinous edge. Moreover, this spur is apparently homologous with the articular process at the end of the shaft of the

ventral bristles, so that the type is conserved, though, as Mr. Southern observes, the view of Ehlers that the dorsal bristle has lost its terminal piece is not tenable.

Southern agrees with Ehlers that *Prægeria* most nearly approaches the Aphroditidæ, resembling the Sigalionidæ "in the reduction of the head and its appendages, the forward position of the buccal segment, the shape of the compound setæ, and the presence of jaws." "I am of opinion that the elongate ventral anterior cirri of the Pisionidæ are homologous to the palps of the Sigalioninæ, that the slender dorsal and globular median cirri, together with the swollen bases, which contain the prominent spines, constitute the parapodia and cirri of the buccal segment, the whole being homologous to the segment bearing tentacular cirri in *Pholoë*, and the first setigerous segment in *Sthenelais*. The first setigerous segment in the Pisionidæ would then be homologous to the first setigerous segment in *Pholoë* and to the second in *Sthenelais*. In all three cases the ventral cirrus of this segment is elongate and functions as a tentacular cirrus—a remarkable resemblance, which is best explained by the theory of close relationship."

Whilst these views are full of interest, it has to be added that no known Sigalionid, or other allied form, shows anything approaching the condition in the cephalic region of *Prægeria* with its remarkable spines, though the proboscis, its circlet of papillæ and its jaws have a near resemblance to those in the Polynoidæ and allied forms. The length of the feet and the proportionally great size of the bristles, which stretch far inward into the tissues of the body, are more in consonance with a pelagic habit than are the bristles and feet of the Sigalionidæ. Further, the bristles themselves have a closer approach to those of the Syllids than to any other group, even to the serrations on the enlarged distal region of the curved shafts. The simple condition of the dorsal bristle is akin to that observed in *Syllis spongicola* and *S. gracilis*, whilst even a more complex arrangement is seen in *Ancistrosyllis grænländica*. On the other hand, the presence of teeth diverges from anything at present known in the Syllids—even from the condition in the parasitic *Syllis* on the eel.

FAMILY SIGALIONDÆ.

STHENELAIS ZETLANDICA, *McI.*

Additional particulars have been obtained by Mr. Southern, who found a complete example. The head is oval, and bears two pairs of kidney-shaped eyes; median tentacle with a basal joint, and on each side is a short, rounded cephalic ctenidium. Palps long and tapered. The first feet project in front of the head, and its ctenidium is near the base dorsally. On the inner margin is the lateral tentacle. Setigerous lobe bears long, slender, dorsal and ventral cirri, and between them the buccal ctenidium—a delicate membrane. A single spine and two fascicles of simple, serrate bristles alone are present. The second feet project laterally; some of the ventral setæ are long and slender, and the terminal pieces have from seven to eight articulations. In the succeeding feet these bristles grow shorter, so that at the fifth two or three articulations only are present in the tips. The dorsal simple setæ are bifid at the tip in Irish specimens, according to Southern, but this unusual feature in a Sigalionid is absent from the original incomplete example. The ventral cirri of the second feet are longer than those which follow, and are nearer the median line; and the

ventral surface is thickly covered with minute globular papillæ, except over the nerve-cords. Southern thinks it is closely allied to Pruvot and Racovitza's *S. minor*, though different.

Habitat.—Dredged in 14 fathoms in Clew Bay (Southern).

PHOLOË TUBERCULATA, *Southern*, 1914. Plate CXXXVI, fig. 2—head.

Specific Characters.—Head with a large facial tubercle. It differs from *P. minuta* in the absence of papillæ on the tentacular cirri, in the more minute papillæ on the feet and ventral surface; papillæ on the scales shorter, and only in one row; arrangement of the bristles in lateral bundles; ventral bristles have stronger teeth and shorter tips in the anterior fascicles. Hitherto it has been found only on the West Coast of Ireland (Southern).

SYNONYMS.

1914. *Pholoë tuberculata*, Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 57, pl. vi, figs. 14A—L.
 1921. „ „ McIntosh. Ann. Nat. Hist., ser. 9, vol. viii, p. 294.

Habitat.—Between tide-marks in Blacksod Bay, and dredged in 9—11 fathoms in Laminarian roots in Clew Bay (Southern).

Were the facial tubercle present in *P. minuta*, then the other characters of *P. tuberculata* might reasonably be construed as those of a variety of the common form, viz., the “absence of papillæ on the tentacular cirri” (since some occur at their base), the more numerous papillæ on the feet and the ventral surface, and the shorter papilla on the scales. The occurrence of white pigment in the palps and scales is a feature of the variety. No facial tubercle, however, has been made out in the common form, therefore Southern's species stands, and is distinguished by the presence of this appendage, the bifid dorsal bristles, and short clavate cilia on the margin of the scales.

FAMILY PHYLLODOCIDÆ.

ETEONE DEPRESSA, *Malmgren*, 1865. Plate CXXXIV, fig. 7—head; 7a—tail; 7b—foot; 7c and 7d—bristles.

Specific Characters.—Head somewhat conical, with a smoothly rounded anterior border; from the sides spring four subulate tentacles of nearly equal length. Snout constricted behind these, gradually widens till near the posterior border, where a slight constriction again occurs; posterior end with a central peak. In front of the centre of the head is a minute “boss” or papilla. On each side and a little in front of the latter is a small eye. Peristomium with two tentacular cirri similar to and scarcely longer than the tentacles. Body about $3\frac{1}{2}$ inches long and $\frac{1}{13}$ of an inch wide in life, flattened both dorsally and ventrally, the latter having a broad median depressed band, and a short lateral area in each segment. Median dorsal line slightly convex, and an elevation at the outer border of each segment.

It tapers a little toward the snout, and more gradually toward the tail, which ends in two spathulate cirri. Foot with an ovato-rotundate dorsal lamella with a short cirrophore. Setigerous process bluntly conical, the tip being double (with a bite in the middle), supported by a pale spine. Bristles translucent, shaft with a distal curvature, its convexity directed upward; terminal piece slightly larger than in *Eteone picta*, and forms a translucent, tapering, serrated blade. The shaft above the dilatation carries a long, tapering spur curving toward the serrated edge of the blade. Ventral cirrus anteriorly a truncated cone.

SYNONYMS.

1865. *Eteone depressa*, Malmgren. Nord. Annul., p. 103, Tab. xv, fig. 36.
 1878. „ „ Théel. Annel. N. Zembla, p. 32, pl. ii, figs. 19 and 20.
 1883. „ „ ? Levinsen. Vid. Meddel. nat. Forhandl. Copenhagen, p. 208.
 1911 ? „ „ Fauvel. Annel. Arctique, p. 27, pl. i, fig. 6.
 1912. „ „ McIntosh. Ann. Nat. Hist., ser. 8, vol. x, p. 119, pl. v, figs. 1—5.

Habitat.—Between tide-marks at Scarborough (Irving and Arnold Watson).

Abroad it has occurred at Bellsund and Whalers' Point, Spitzbergen (Malmgren); Greenland (Pröven); Nova Zembla (Théel); Murman Sea (Fauvel) ?

The head (Plate CXXXIV, fig. 1) is somewhat conical, with a smoothly rounded anterior border, from the sides of which spring the four subulate tentacles, which taper distally and are nearly equal in length. Behind these the snout is constricted, then gradually widens till near the posterior border, when a slight constriction again occurs, thus giving a characteristic outline to the prostomium, the posterior border of which is carried backward in the middle line. Just in front of the central point is a minute boss, the presence of which at once attracted Mr. Watson's attention, and which, though in a different position, simulates the unpaired tentacle of *Eulalia*. On each side and a little in front of the boss is a comparatively small eye, quite distinct at first, but which gradually faded in the preservative fluid, as, indeed, happens to other species of the genus. The peristomium bears two tentacular cirri of similar shape to the tentacles and scarcely longer.

The body is about $3\frac{1}{4}$ inches long and about $\frac{1}{13}$ of an inch wide (Watson) in life, and it is flattened both dorsally and ventrally, the latter surface being distinguished by a broad median depressed band and a short lateral area in each segment. On the dorsum, again, a similar effect is produced by the slight elevations at the outer border of each segment, though the median section is slightly convex and of the colour formerly mentioned. It tapers a little toward the snout, and much more gradually toward the tail, which ends in two lobate or spathulate cirri (Plate CXXXIV, fig. 2). The segments throughout are well marked, and in the preservative fluid ($2\frac{1}{2}$ per cent. formalin in sea-water and then alcohol) a curious increase of the pigment has occurred, with pale segment-junctions. The dorsal and the ventral cirri are dark like the ventral surface, but the setigerous processes remain pale; such of course, though interesting, is the effect of the preservative fluid, and must not be confounded with its original pallor. The colour when alive was whitish or cream-coloured, but in sea-water with $2\frac{1}{2}$ per cent. of formalin it passed through lemon-yellow to a dark brown, the tints being darker in some parts than in others, whilst a few points remained cream-coloured.

The feet form an even series along each side, the typical foot (Plate CXXXIV, fig. 7b) having dorsally an ovate-rotundate lamella, which varies a little in the posterior region—that is, becomes more elongate and therefore more conical. The cirrophore supporting it anteriorly is short and broad, the base of the cirrus being constricted in the posterior segments as it approaches it, whereas in the anterior segments the low broad cone formed by the cirrus shows this less prominently. The distal extremity forms a blunt cone. This cirrus, as in one or two other species of the genus, is proportionally large in a lateral view of the foot, its cirrophore occupying about half the vertical diameter of the foot, and it extends distally much beyond the other divisions. The setigerous process is bluntly conical, the tip being double, with a bite in the middle, and the bristle-tuft is supported by a pale spine, the tip of which does not project beyond the surface, though it almost touches it. The bristles (Plate CXXXIV, figs. 7c and 7d) are translucent, with a distal curvature of the shaft, and form a broad fan anteriorly, with the convexity of the shaft directed upward. The terminal piece is perhaps slightly longer than in *Eteone picta*, and forms a translucent tapering serrated blade. The shaft is dilated at its termination above the curvature, and carries a long tapering spur, the point of which curves toward the serrated or upper border of the terminal blade; and on the same side (that is, with the serrated edge of the blade to the left) is a shorter spur and a series of diminishing serrations on the free edge below it. The bristle thus differs from that of *Eteone picta*, especially in the proportionally longer hook at the end of the shaft and the more coarsely spinous edge below the base of the larger process. In *E. picta* the large hook is shorter, stronger, and more boldly curved, and the lateral hook smaller. In *E. arctica* the great hook is likewise shorter and stouter. In *E. lentigera* the comparatively small though stout main hook is only a little larger than the secondary. In *E. spetsbergensis* the secondary hook is long and sharp and runs parallel to the larger hook, which is more or less straight. In the posterior region of the body both spines are well developed, and some have a tendency to curve at the tip. In *E. pusilla* the disproportion between the two hooks or spines is great, the smaller, however, being slender and sharp. In some, small spines abut on the larger toward the dorsal edge of the terminal blade—that is, the side opposite the serrated edge. The blade, moreover, is perhaps more distinctly bellied inferiorly.

The ventral cirrus anteriorly has the shape of a truncated cone, the tip of which projects beyond the setigerous lobe. In the posterior third this cirrus diminishes in bulk and its tip is nearly in a line with the setigerous process, its ventral outline presenting a swelling or hump—apparently an indication of its approach to the fused cirrophore. Toward the tip of the tail, again, both the setigerous lobe and the ventral cirrus have diminished in bulk, the latter especially being longer and more slender, and its tip often projects beyond that of the setigerous lobe, the bristles in which are fewer and shorter.

This form generally resembles *Eteone depressa*, Malmgren, and especially in the structure of the feet and bristles, but it differs in the presence of the “boss” or tentacle at the posterior border of the prostomium. If the various authors who have examined it, however, had only seen spirit-preparations, it is possible that it may have been overlooked.

I am indebted to Mr. Arnold Watson for his courtesy, as on many other occasions, in forwarding the example, and for his notes and sketches of the living form.

Théel (1879), in a brief note, states that the head differs from Malmgren's outline, and he gives a corrected figure.

Fauvel (1911) considers that this species may be identical with *Eteone spetsbergensis*, Malmgren, but, as indicated in the foregoing remarks, there are reasons for keeping them separate.

Southern¹ considers that *Eteone spetsbergensis* and *E. pusilla* are identical, and that De Quatrefages² species, *E. foliosa*, is the same form, and he adopts the latter title. Whatever the ultimate view may be, the bristles of Southern's *E. foliosa* (Plate XXXV, fig. 19) are identical with those of *E. spetsbergensis*, Malmgren, whose title has as much reason to be retained as that of De Quatrefages, more especially as his figures and description are readily followed.

EULALIA PUSILLA, *Ørsted*, 1843. Plate CXXXIV, fig. 8—bristle.

Specific Characters.—Head conical, rounded in front; eyes situated posteriorly; median tentacle small; first pair of tentacular cirri on the buccal segment; the second and third pairs occur on the second segment, and the superior is the longer, whilst below is a rudiment of a foot with a bristle-tuft. The third segment has the fourth pair of tentacular cirri as long as the preceding, a bristle-tuft and a ventral cirrus. Body 8 lines long, greyish-green or brownish, with brown or green cirri, with a green dorsal stripe in the middle line, whilst ventrally two brownish points occur at the exterior of each segment; segments thirty to eighty; small ovoid dorsal cirri on the fourth segment; all the dorsal cirri easily detached, and they do not overlap. The anal cirri resemble the dorsal. Proboscis covered with minute papillæ, and with a circle of twenty-four comparatively large blunt papillæ. Bristles with three minute spines on the end of the shaft, and the terminal piece is serrated.

SYNONYMS.

1843. *Eulalia pusilla*, *Ørsted*. Annul. Dan., p. 27, fig. 81.
 1865. „ „ Malmgren. Nord. Annel., p. 102, pl. xv, fig. 37.
 1867. „ „ Idem. Annul. Polych., p. 26.
 1888. „ „ De St. Joseph. Ann. Sc. nat., 7^e sér., t. v, p. 287, pl. xi, figs. 149—150.
 1914. „ „ Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 66.
 1921. „ „ McIntosh. Ann. Nat. Hist., ser. 9, vol. viii, p. 296.

Habitat.—In Laminarian roots between tide-marks, and dredged also in 1 fathom in Blacksod Bay, Ballynakill Harbour in 2—4 fathoms, Loch Swilly (Southern).

North Sea (*Ørsted*); Sweden (*Lovén*); Dinard, France (*De St. Joseph*).

This minute species has probably been overlooked in the collections of British observers until Southern's careful investigations showed that it is not uncommon on the West Coast of Ireland, whilst *De St. Joseph* dredged it frequently at Dinard. The dorsal cirrus is elongate-ovoid, and the two anal cirri are similar. The setigerous process bears a fascicle of slightly curved, short bristles with enlarged ends of the shafts and tapered terminal pieces with serrations (Plate CXXXIV, fig. 8). A female bore ova of considerable size in July.

As formerly stated, *Eulalia ornata*, *De St. Joseph*, and *Eulalia aurea*, *Gravier*, both

¹ 'Proc. Roy. Irish Acad.,' vol. xxxi, 47, p. 76.

² 'Annelés,' ii, p. 146.

of which are entered in the Plymouth list, appear to be only varieties of the common form, viz., *E. viridis*.

MYSTIDES (MYSOMYSTIDES) LIMBATA, *De St. Joseph*, 1888. Plate CXXXIV, fig. 9—bristle.

Specific Characters.—Head bearing four minute tentacles in front, and posteriorly two large, reddish eyes. Body 7—20 mm. long, with forty to ninety segments. Buccal segment with two slender tentacular cirri; the following segment with another pair, and the ventral showing a slight enlargement. Proboscis with a ring of about ten papillæ, and its inner surface is coated with large conical papillæ. Anal segment has a pair of fusiform cirri. The foot has oval dorsal and ventral cirri, and a bifid setigerous lobe. The short and stout bristles are curved, and the end of the shaft has a strong tooth and a series of spines on each side. The distal blade is coarsely serrated and obliquely striated. Mature males and females are provided with swimming-bristles (*De St. Joseph*), which in a female of ninety-two segments extended from the thirty-fifth backward.

SYNONYMS.

1888. *Mystides (Mysomystides) limbata*, *De St. Joseph*. Ann. Sc. nat., 7^e sér., t. v, p. 310, pl. xiii, figs. 186—192.
 1896. „ *limbata*, *Gravier*. Bull. Sc. Fr. et Belg., sér. 4, t. xxix, p. 299 *et seq.*
 1914. „ (*Protomystides*) *limbata*, *Southern*. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 72, pl. viii, figs. 18 A, B.
 1915. „ *limbata*, *Allen*. Journ. M. B. A., vol. x, p. 518.
 1921. „ „ *McIntosh*. Ann. Nat. Hist., ser. 9, vol. viii, p. 297.

Habitat.—West Coast of Ireland (Southern); Plymouth (Allen). Shores of France (*De St. Joseph*, *Gravier*).

This is a small form, the head bearing four minute tentacles in front, and two large reddish eyes posteriorly. The buccal segment has two slender tentacular cirri, and the following segment has another pair, the ventral presenting a slight enlargement. The proboscis has a ring of about ten papillæ, and its inner surface is coated with large conical papillæ. The anal segment has a pair of fusiform cirri. The foot has oval dorsal and ventral cirri and a bifid setigerous lobe. The short, stout bristles (Plate CXXXIV, fig. 9) are curved, and the distal end of the shaft has a strong tooth and a series of spines on each side. The terminal blade is coarsely serrated and obliquely striated. Mature specimens have swimming-bristles.

Southern distinguishes it by the fan-shaped array of spines at the end of the shaft of the bristles (a feature, however, found in other forms), and by the winged expansion of the ventral tentacular cirrus on the second segment. *Allen* observes that a female with dark green eggs occurred in May, and that a small median tentacle exists as in *Eulalia*, “but in the majority of specimens it is difficult, if not impossible, to make it out.”

De St. Joseph points out that certain Phyllodocids, such as *Eulalia problema*, *Mgrn.*, have capillary bristles as in Syllids, and that *Eulalia gracilis*, *Verrill*, showed signs of scissiparous development. The presence of large eyes and capillary bristles in *M. limbata* is another example, and he thinks it probable that at maturity these will be fully developed

MYSTIDES (PROTOMYSTIDES) BIDENTATA, *Langerhans*, 1880. Plate CXXXIV, fig. 10—bristle.

SYNONYMS.

- Habitat*.—Dredged in 24 fathoms, Clew Bay, and in 16 fathoms near Bofin Harbour (Southern).

The head is elongate, and the tentacular cirri long. The body has about 190 segments, and measures from 5—25 mm., the colour being greenish-yellow, and a dark brown spot exists at the base of each foot ventrally. The anal segment has two slender cirri enlarged at the base, and a long papilla between them. The feet have ovate cirri, and the setigerous lobe is bifid. The ventral bristles are thicker than the median, and the terminal pieces shorter; dorsal bristles intermediate. The dilated and bevelled tip of the shaft bears two unequal claws, and is spinous (Plate CXXXIV, fig. 10). The bristles are longer and more slender than in *M. limbata*, and the ventral cirri of the second segment are large. Mature forms have swimming-bristles. In contrast with *M. limbata*, the coloration of this species differs, and the dorsal and ventral cirri appear to be proportionally larger.

Specific Characters.—Head rounded in front, broader behind, and has four long, slender tentacles. No eyes in some. Nuchal grooves between the head and first segment, which bears a single pair of tentacular cirri. Two pairs of tentacular cirri on the second segment, the dorsal being the larger, and all have a basal articulation and a swelling above it. Body $5\frac{1}{2}$ mm. in length, and has thirty-eight or more segments. Colour greenish-yellow in

preserved examples—the cirri being especially tinted. The third segment has no dorsal cirri. Dorsal and ventral cirri of the following segments are round or broadly oval. Anal segment with two large oval cirri, and between them a short papilla. Bristles have shafts with enlarged ends, and two long, equal spinous processes or claws; the terminal blade is long, slender, minutely serrated and obliquely striated.

SYNONYMS.

1878. *Mystides borealis*, Théel. Annél. Nouv. Zemb., p. 35, pl. ii, figs. 29—32.
 1880. „ *cæca*, Langerhans. Zeitschr. f. wiss. Zool., Bd. xxxiii, p. 310, Taf. xvi, fig. 42.
 1887. „ *viridis*, Webster and Benedict. U.S. Com. F. and F., p. 712, figs. 10—12.
 1913. „ *cæca*, Fauvel. Polych. Bull. Institut. Oceanogr., No. 270, p. 53.
 1914. „ *borealis*, Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 72, pl. viii, figs. 19 A—D.
 1921. „ „ McIntosh. Ann. Nat. Hist., ser. 9, vol. viii, p. 298.

Habitat.—Dredged at 24 fathoms in Clew Bay on sand and shells, and on similar ground off Dingle Bay in 78 fathoms (Southern).

Distribution.—Nova Zembla; Madeira (Langerhans); Monaco (Fauvel); Eastport, Maine (Webster and Benedict).

This is another of the minute examples ($5\frac{1}{2}$ mm. long) of the genus which can be best studied in the living condition, and it is possible that revision may alter certain of the views at present held. Southern's careful descriptions, however, will aid materially in their elucidation. The broadly oval cirri of this form are conspicuous. The bristles are slender and of moderate length (Plate CXXXIV, fig. 11).

MYSTIDES ELONGATA, *Southern*, 1914. Plate XXXV, figs. 1 and 1a—bristles.

Specific Characters.—Head twice as long as broad; eyes two in postero-lateral angles, no lenses; four long, slender tentacles in front. Body slender, elongate (6 mm.), and has eighty segments, colour yellowish or dark green. First segment has a single pair of long, tapering cirri; the second has two pairs. No trace of bristles or spines on the second segment. Third segment with a setigerous lobe with bristles and a ventral cirrus. Foot has a bluntly pointed setigerous lobe, with a spine and four bristles; dorsal cirri small and fusiform; ventral cirri longer, slightly enlarged in the proximal half and attached near the middle of the setigerous lobe, but posteriorly increasing in length and moving toward the tip of the lobe. In each foot three of the bristles are compound, the shaft being thick, curved and bevelled, as well as bifid, but not swollen at the tip; terminal piece short, wide at the base, tapering to a fine point, and with coarse striations. The second bristle is thinner, and terminates in a flattened, coarsely striated expansion—with a fine point—which Southern thinks is a fused terminal piece, the fusion being most complete posteriorly. Muscular stomach in segments 11—13. Mature female has bluish-green eggs, commencing in the twenty-ninth segment.

SYNONYMS.

1914. *Mystides* (*Mesomystides*) *elongata*, Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 74, pl. v, fig. 12.
 1921. „ *elongata*, McIntosh. Ann. Nat. Hist., ser. 9, vol. viii, p. 298.

Habitat.—Dredged in Clew and Dingle Bays on a bottom of sand and shells or gravel (Southern).

A remarkably elongated form with long setigerous processes, long segments, and peculiar bristles. The head is twice as long as broad, and has two eyes, devoid of lenses, in the postero-lateral angles. The body is minute (6 mm.) and has eighty segments. The colour is yellowish or dark green. The first segment has a single pair of long, tapering cirri, the second has two pairs, but there are no traces of spines or bristles. The third segment has a setigerous lobe and a ventral cirrus. The setigerous lobe generally is bluntly pointed, and has a spine and four bristles; whilst the dorsal cirri are small and fusiform; ventral cirri longer. Three of the bristles in each foot are compressed, the shaft being thick, curved, bevelled (but not swollen at the tip) and bifid.

Genus PELAGOBIA, Greef, 1879.

Head with four tentacles and two eyes. Four tentacular cirri, and elongated feet; dorsal and ventral cirri cylindrical. Proboscis short; alimentary canal straight. Body slender, with about twenty-four segments in the longest example, and terminating in two caudal styles. Bristles with two spikes at the base of the serrated, tapering, terminal region.

PELAGOBIA LONGICIRRATA, Greef. Plate CXXXIV, figs. 4 and 4a.

Specific Characters.—Head with two eyes and four tentacles, all arising in front of the eyes. Four tentacular cirri. Proboscis short and rounded. Body elongated (7.5 mm.), more tapered posteriorly than anteriorly, twenty-four or more segments. Feet well developed. Dorsal and ventral cirri cylindrical and slightly tapered. Bristles with translucent straight shafts dilated distally, and a broad, tapering, serrated terminal piece hooked at the tip. Pelagic.

SYNONYMS.

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| 1879. | <i>Pelagobia longicirrata</i> , | Greef. | Zeitschr. f. wiss. Zool., Bd. xxxii, p. 247, Taf. xiv, figs. 23—25. |
| 1886. | „ | Vignier. | Arch. Zool. Expér., 2 sér., t. iv, p. 377, pl. xxi, figs. 1—13. |
| 1895. | „ | Reibisch. | Phyllodoc. u. Typhloscol. Plankton-Exped., p. 21, Taf. ii, figs. 1—9. |
| 1897. | „ | Vanhöffen. | Grönl. Exp. der Gesellschaft f. Erdkunde in Berlin, Bd. ii, p. 217. |
| 1905. | „ | Reibisch. | Nord. Plank., x, p. 3. |
| 1909. | „ | Southern. | Irish Sc. Invest., iii, p. ii, pl. i, fig. 1. |
| 1916. | „ | Fauvel. | Camp. Sc. Monaco, Fasc. xlviii, p. 61, pl. i, figs. 6 and 7. |
| 1921. | „ | McIntosh. | Ann. Nat. Hist., ser. 9, vol. viii, p. 294. |

Habitat.—Post-larval examples procured in February in the Irish Sea (Chadwick). Various examples of the adult were obtained by the S.S. “Helga,” of the Irish Fisheries Department, chiefly at considerable depths off the West Coast of Ireland (Southern).

The post-larval examples procured in the Irish Sea¹ present two stages—different from those figured by Reibisch, but agreeing in general structure. The younger has three bristled segments (Plate CXXXIV, fig. 4), the large head (for at its posterior border it is equal to the diameter of the body), is broadly shield-shaped, the narrower border being anterior. Two eyes—antero-posteriorly elongated—occur toward the posterior border and are widely separated. A tentacle projects on each side of the anterior margin. The second pair arise behind each eye, are subulate in shape, and slant forward. A pale area in the centre of the snout indicates the mouth, which is at the anterior extremity; a small ovoid area occurs in the lateral region, and probably indicates the nuchal organ, which is conspicuous in Greef's form. The head thus differs from Greef's in the antero-posteriorly elongated eyes and in the brevity of the tentacles, but it has to be remembered that his form is much more advanced.

The *body* is nearly cylindrical, though the two terminal segments are considerably narrower, and has three bristled segments, the first feet being the shortest, a brief interval separating them from the head. Each forms a simple blunt cone standing at right angles to the body and furnished with a series of delicate translucent bristles with articulated terminal pieces like those of Phyllodocids. The second feet are considerably larger, also stand nearly at right angles to the body, and their bristles are longer and stronger. The third pair slope distinctly backward. Each foot, except the last, has a small subulate dorsal cirrus which projects only a little beyond the tip of the setigerous lobe, and is in contrast with the two long cirri of Greef's type. Behind the third foot is a narrow segment with a slight lateral projection from which a single bristle projects. Then follows the still narrower anal segment which has two subulate anal cirri. If Reibisch's figures are to be trusted, this species would appear to differ, since he shows only two conical processes terminating the body, but perhaps the cirri had been lost. In the original description of Greef the anal cirri are almost bulbous at the base, with a terminal slender, subulate process.

The proboscis occupies the first bristled segment, is nearly circular in outline, with a median fissure from which transverse striæ pass. A narrow process of the gut joins this to an enlargement between the second and third feet, after which the intestine diminishes to the terminal vent.

The second example (Plate CXXXIV, fig. 4a) has advanced a little, since the fourth foot now projects with its tuft of bristles, the anal segment remaining as before. The anal cirri spring close together on the ventral surface, and extend backward as short subulate processes, their total length being about the transverse diameter of the anal segment. They present no bulbous base as in Greef's species, and differ from the stumpy, conical condition shown throughout all the stages of Reibisch's examples.

Greef's² specimens were procured in the Bay of Arrecife, Canary Islands, from January to May. The body had fifteen segments and was 3 mm. in length. The head and first segment had a reddish tint; the rounded, reddish-brown eyes, situated a little behind the bases of the dorsal tentacles, had lenses; whilst the mouth opened at the tip of the snout. On each side of the posterior part of the head is a ciliated, lobate nuchal organ. The first segment bears a pair of rather long cirri and a setigerous process; the second has shorter cirri, but the third, again, has somewhat longer cirri, and they get broader posteriorly. The

¹ For these examples I am indebted to Mr. Chadwick, of the Port Erin Marine Laboratory.

² 'Zeitschr. f. wiss. Zool.,' Bd. xxxii, p. 247, Taf. xiv, figs. 23, 24 and 25.

bristles borne by the setigerous process have straight shafts, a bifid spur with a longer and a shorter sharp process and a serrated terminal process with the spikes directed distally. He describes a dorsal vessel as in *Pontodora* in ripe examples, which had either ova or sperms. The alimentary canal has a muscular pharynx with a glandular (?) central region. He was uncertain as to the position of the species, but thought it might be near the Syllids.

Viguier¹ (1886) found the same form in the Bay of Algiers from December onward throughout the year. He points out that the mouth is not terminal, but on the inferior surface of the head, behind the ventral pair of tentacles, a ciliated furrow passing in front of the inferior tentacles, and terminating superiorly in front of the dorsal tentacles. The groove separating the prostomium is also ciliated. He shows that the antero-posteriorly elongated eyes rest on the cephalic ganglia, which are bar-like from transverse extension. The nuchal organs form two lateral ciliated processes on each side between the first foot and a point opposite the eye. The proboscis has a series of parallel longitudinal glands, with enlarged or bulbous ends posteriorly in the centre of the organ, and when the latter is extended these bulbous ends are distal, the tip of the organ having a smooth border. He describes and figures the pygidium as a short cone with a minute process in the centre, and a circle of cilia a little in front. The foot has a spine and a group of bristles, the tip of the shaft being bevelled, and a serrated terminal blade articulated with it. The generative elements fill the coelom, and even pass forward into the sides of the proboscis in extrusion. He considers that the form belongs to the Phyllodocidæ. The figures of this author are excellent, and in contrast with those of Reibisch, who, however, had only preserved materials.

Much larger and older examples were procured by the Prince of Monaco at 2300 m. off the Gulf of Juan, and at 4800 m. off Portugal, the latter of a bright reddish orange, and apparently having over twenty setigerous segments. According to Ehlers, the *Pelagobia viguieri* of Gravier represents an older stage of Greef's *P. longicirrata*. It would appear that the older stages frequent deep water.

Reibisch (1895) gave an account of the development of what he considered to be the same species (*P. longicirrata*) as Greef's, though slight differences are apparent. He figures the eggs and the young without tentacles, but with two eyes, two feet and two anal cirri, and various stages up to the longest with twenty-four segments, and considers that it approaches the young of *Eteone*. Its distribution is almost cosmopolitan.

In general outline the early stages of *Pelagobia* somewhat resemble the larval stages of *Sphærodorum*, but differ in certain details, such as the median cephalic and caudal processes and the papillæ on the body, whilst the bristles seem to be proportionally longer.

Pelagobia is extensively distributed abroad—chiefly in the warmer seas of both hemispheres, yet it occurs in the waters of Greenland and ranges through the intermediate area to the South Pacific, and appears at various seasons.

PELAGOBIA SERRATA, *Southern*, 1909.

Specific Characters.—Head rounded in front, apparently devoid of eyes.

All the specimens were imperfect, but generally agreed with the outline of *P. longi-*

¹ 'Arch. Zool. Expér.,' 2^e sér., t. iv, p. 377, pl. xxi, figs. 1—13.

cirrata. At the tip of the extruded proboscis are dark glandular masses. A touch of yellow pigment on each side above the first feet.

Feet with the dorsal cirri longer than *P. longicirrata*, though the setigerous processes of the first and second feet are small.

Bristles shorter and more slender than in *P. longicirrata*, with the distal end of the shaft serrated, and the terminal piece is much narrower than in the former species, and presents no hook at the tip.

SYNONYMS.

1909. *Pelagobia serrata*, Southern. Irish Sc. Invest., No. 3, p. 3, pl. i, figs. 2, 3.

1916. „ „ Fauvel. Camp. Sc. Monaco, Fasc. xlviii, p. 62.

Habitat.—Frequents similar regions to the former species, but at greater depths off the West Coast of Ireland, viz., from 600 to 1000 fathoms (Southern).

The imperfect condition of the examples leaves a certain margin of doubt, but so far as can be observed at present, Mr. Southern's distinctions are reasonable.

MAUPASIA CÆCA, *Viguier*, var. ATLANTICA, *Southern*, 1909.

Specific Characters.—Head with four slender tentacles and three pairs of tentacular cirri of nearly equal length, and traces of a fourth pair. No eyes. Nuchal organs well developed and curiously lobed.

Body 4.5 mm. or more in length, with thirteen setigerous segments. Foot short and blunt, the dorsal and ventral cirri projecting beyond its tip. The dorsal cirrus is foliaceous, the ventral long and slender. The bristles are more slender and elongate than those of the type, and the terminal piece rests on a process considerably within the tip of the shaft, which is pointed. The terminal piece is very slender.

SYNONYMS.

1886. *Maupasias cæca*, Viguier. Arch. Zool. Expér., t. iv, p. 382, pl. xxi, figs. 14–20.

1909. „ „ var. *atlantica*, Southern. Irish Sc. Invest., No. 3, p. 4, pl. i, figs. 4 and 5.

1912. „ „ Ehlers. Nat. Antarctic Exped., vol. vi, p. 15.

1913. „ „ idem. Polych. Deut. Sudpol. Exped., vol. iii, Zool. v, p. 462.

1922. „ „ McIntosh. Ann. Nat. Hist., ser. 9, vol. ix, p. 1.

Habitat.—Secured in a tow-net on trawl in 411 fathoms, in lat. 51° 54' N. and long. 11° 57' W. (Southern).

Distribution.—Atlantic, Mediterranean, Antarctic.

HALIPILENES MAGNA, *Southern*, 1909.

Specific Characters.—The head is rounded in front; dorsal tentacles as long as the head is wide, and slightly longer than the ventral pair, which are placed far back, just in front of the mouth. At the base of the head dorsally is a wide collar, projecting laterally, and continued on the ventral side behind the mouth. No eyes. Body 3–6 mm. long;

segments thirty-five; width across the feet 1 mm. Colour in spirit pale yellowish brown. Foot with the pointed setigerous lobe projecting beyond the cirri, and the tip of the spine is just visible. The dorsal cirrus is pear-shaped, the ventral bluntly conical. Bristles with slightly curved shafts and a prominent process at the tip. The terminal piece is long and slender, two to three times as long as the free portion of the shaft (Southern).

SYNONYMS.

1909. *Halipenes magna*, Southern. Irish Sc. Invest., No. 3, p. 5, pl. i, fig. 6, pl. ii, figs. 7—11.

1922. „ „ McIntosh. Ann. Nat. Hist., ser. 9, vol. ix, p. 2.

Habitat.—Procured in the tow-net at 700 fathoms off the West Coast of Ireland in February, lat. $54^{\circ} 57' N.$, long. $10^{\circ} 51' W.$

It is longer and has more numerous segments than either *H. gracilis* or *H. isochaeta*.

No member of the Lopadorhynchinae—a group most nearly approaching the Phyllocodidae—has been met with by the author in the British Seas from Shetland to the Channel Islands. Mr. Southern, however, by the enterprise and liberality of the Irish Fisheries Department, has described a few from the deep water off the West Coast of Ireland, and all were rare except two species of *Pelagobia*.

LOPADORHYNCHUS APPENDICULATUS, Southern, 1909.

Specific Characters.—The dorsal tentacles on the head are twice as long as the ventral, which are not seen from the dorsum. The ventral tentacular cirri are somewhat longer than the dorsal, and on the basal piece of the ventral is a rudiment of the third pair; four eyes or none visible. Body 5—13 mm. long and narrowed posteriorly. Segments twenty-three, of which twenty-two are setigerous. Dorsally each segment is marked by a transverse ridge running along the middle, so as to have lozenge-shaped depressions in each inter-segmental area, and ridges also occur ventrally. First and second segments have only simple bristles, whilst the third have both simple and compound. The rest have only compound. Feet anteriorly modified, but the typical foot occurs at the seventh (where the body is widest), which has a pointed setigerous lobe with a spine, and near it a simple hooked bristle, and a rounded setigerous lamella with seventy-six compound bristles. The dorsal cirrus is conical, and larger than the ventral, the tips of both being within that of the setigerous lobe. The ventral cirrus has a filiform process at the tip, and the aperture of a multicellular gland near its base. Small granules of dark purple pigment occur on the inner sides of the cirri.

The same pelagic form was described by Prof. Fauvel as *L. uncinatus* a few years later, and he emphasised the presence of the hooked bristles in the first two feet by his title to the species.

SYNONYMS.

1909. *Lopadorhynchus appendiculatus*, Southern. Irish Sc. Investig., 3, p. 7, pl. ii, figs. 12 and 13, pl. iii, figs. 14—20.

1915. „ „ *uncinatus*, Fauvel. Bull. Inst. Oceanogr., No. 305, p. 3, 2 text-figs.

1922. „ „ *appendiculatus*, McIntosh. Ann. Nat. Hist., ser. 9, vol. ix, p. 2.

Habitat.—Procured at the surface over 450 fathoms, lat. $50^{\circ} 48' N.$, long. $12^{\circ} 4' W.$, and in tow-net at 530 fathoms, lat. $54^{\circ} 50' N.$, long. $10^{\circ} 45' W.$, off the W. coast of Ireland.

Elsewhere it has been found off the Azores, the Canaries, and in the Mediterranean (Fauvel).

FAMILY ALCIOPIDÆ.

Cephalic lobe distinct, with two large and prominent eyes of complex structure; anterior border with four tentacles (palpi of some); tentacular cirri five; proboscis exsertile, with a papillose margin and two long papillæ.

Body more or less elongate, glassy; feet uniramous, a single spine and a tuft of simple or compound bristles; dorsal and ventral cirri foliaceous.

Genus VANADIS, Claparède, 1870.

Head not produced beyond the eyes. Proboscis unarmed. Tentacular cirri simple, five pairs; feet with cirriform appendages, and slender bristles, to which are articulated tapering, hair-like tips.

VANADIS FORMOSA, Claparède, 1870.

Specific Characters.—Cephalic lobe short, eyes of medium size, short tentacles. Palpi cirriform, in front of the mouth. Body colourless or faintly coloured brownish pink, elongated, measuring 30 cm., with a breadth of 5 mm., segments 220. Pharynx 33 mm. long, with two long, cirriform papillæ, and between them small lobate papillæ. Foot with lanceolate setigerous process, cordiform dorsal lamella, and foliaceous ventral lamella. Glands on all the middle and posterior segments. Spine nearly embedded in the foot, the bristles penetrating only superficially. In the female the first two feet have the seminal sacs ventrally, and the ten anterior feet are smaller than the succeeding. Tail with a single filiform cirrus.

SYNONYMS.

- 1860. *Alciopa Krohnii*, Hering. De Alciop. genit. org. excret., p. 12.
- 1870. *Vanadis formosa*, Claparède. Annél. Nap. Suppl., p. 116, pl. x, fig. 3.
- 1876. „ *pelagica*, Greef. Nova Acta K. Leop.-Carol. Akad., Bd. xxxix, ii, p. 67.
- 1878. „ *greiffiana*, Grube. Annel. Gazelle, p. 524.
- 1885. „ *formosa*, Carus. Fauna Medit., i, p. 246.
- 1890. „ *longicauda*, Apstein. Spengel's Jahrb., Bd. v, p. 7.
- „ „ *latocirrata*, idem. Ibid., p. 7.
- 1892. *Alciopa Krohnii*, Hering. Sitz. K. Akad. Wiss. Wien, p. 738.
- 1911. *Vanadis formosa*, Southern. Irish Sc. Invest., No. 3, p. 2.
- 1916. „ „ Fauvel. Annél. Pelag. Monaco, p. 65.
- 1922. „ „ McIntosh. Ann. Nat. Hist., ser. 9, vol. ix, p. 13.

Habitat.—West Coast of Ireland, in midwater trawl near deep water, though also in 5 fathoms (Southern).

Extends to the Mediterranean, Atlantic, Indian and Pacific Oceans.

Genus GREEFIA, *McIntosh*, 1885.

Eyes large and lateral; foot with two appendages and slender compound bristles.

GREEFIA REYNAUDII, *Audouin and Edwards*, 1833.

Specific Characters.—Head larger than the neck; two large lateral brown eyes, with the corneæ directed outward; a bridge of tissue between the eyes posteriorly. A well-marked isthmus between the eyes in front. Body slightly tapered toward the front, and more distinctly posteriorly, upwards of 33 mm. in length. Foot with a conical setigerous process bifid at the tip; a fan-like series of bristles and a massive base to a large crescentic lamella dorsally and a somewhat smaller lamella ventrally. Dorsal and ventral segmental glands of a brownish-olive colour. Bristles slender, tapering to slender tips, which have a terminal process attached to one side.

SYNONYMS.

1834. *Alciopa reynaudii*, Audouin and Edwards. *Annél.*, p. 214, pl. v, figs. 6—11, and *Ann. Sc. nat.*, tom. xxix, p. 216.
1876. *Halodora* „ Greef. *Nova Acta Leop.-Carol. Akad.*, Bd. xxxix, No. 2, p. 55.
 „ *Nauphanta celox*, idem. *Ibid.*, p. 69.
 „ „ *spectabilis*, idem. *Ibid.*, p. 56.
1882. „ *celox*, Levinsen. *Norske Annel.*, p. 331.
1885. *Greefia celox* and *oahuensis*, McIntosh. *Annel. "Challenger,"* pp. 182—3, pl. xxxviii, figs. 5—7, pl. xxxii, fig. 11, pl. xv A, fig. 4.
- 1885–6. *Nauphanta celox*, Levinsen. *Kongl. dansk. Vid.-selsk. Skrift.*, 6, Bd. vi, p. 331.
1891. „ „ Apstein. *Alciop. nathist. Mus. Hamburg*, p. 9.
1893. „ „ idem. *Arch. f. nat.*, Bd. i, Heft 2, p. 146.
1900. „ „ idem. *Plankton Exped.*, Bd. ii, H. b., p. 12.
1905. „ „ Reibisch. *Nord. Plank.*, x, *Annel.*, p. 5.
1911. *Greefia celox*, Southern. *Irish Sc. Invest.*, 3, p. 3.
1916. „ „ Fauvel. *Annél. Pelag. Monaco*, p. 67.
1922. „ *reynaudii*, McIntosh. *Ann. Nat. Hist.*, ser. 9, vol. ix, p. 13.

Habitat.—Captured in midwater and at the surface over great depths off the West Coast of Ireland (Southern).

Elsewhere widely distributed over the Atlantic, Indian and Pacific Oceans.

Genus CALLIZONA, *Greef*, 1876.

Head with large lateral eyes and tentacular cirri. Foot with slender bristles, hooked bristles, and lamellar appendages.

CALLIZONA ANGELINI, *Kinberg*, 1866.

Specific Characters.—The head projects considerably in front of the large dorso-lateral eyes, with four tentacles in front and one dorsally at the anterior part of the eyes. Body elongated, of 140 segments or more, terminating posteriorly in a slender tail. Five rather short and thick tentacular cirri. Proboscis with twelve short papillæ anteriorly. Feet anteriorly with cordiform dorsal cirri and ovate cirri ventrally, but in the middle of the body and posteriorly they become more elongate. Anterior dorsal bristles slender, with comparatively thick terminal pieces; ventral bristles thick and curved, with slender terminal pieces. In the middle of the body only one or two thick ventral bristles.

SYNONYMS.

1865. *Krohnia angelini*, Kinberg. Annul Nova, p. 243.
 1876. *Rhynchonerella angelini*, and *Callizona Grubei*, Greef. Nova Acta K. Leop.-Carol. deut. Akad., Bd. xxxix, pp. 57 and 72.
 1885. *Callizona Grubei*, Levinsen. Kgl. dansk. Vid.-selsk. Skrift., 6, Bd. iii, p. 333.
 1891. „ „ Apstein. Jahrb. d. Hbg. wiss. Anst., p. 10.
 1892. „ *angelini*, idem. Festschrift für Leuckart.
 1893. „ „ idem. Arch. f. Naturges., Bd. i, Heft 2, p. 148.
 1900. „ „ and *C. grubei*, idem. Plankton Exped., Bd. ii, H. b, p. 18.
 1905. „ „ Reibisch. Nord. Plank., x, p. 4.
 1911. „ „ Southern. Irish Sc. Invest., iii, p. 4.
 1916. „ „ Fauvel. Annél. Pelag. Monaco, p. 68.
 1922. „ „ McIntosh. Ann. Nat. Hist., ser. 9, vol. ix, p. 13.

Habitat.—Procured in the midwater trawl and tow-net near depths ranging from 600 to 1000 fathoms off the West Coast of Ireland.

Elsewhere it occurs in the North and South Atlantic, the Indian Ocean and the China Sea.

Southern's careful investigations of the type-specimens appear to leave no doubt as to the identity of the two forms *C. angelini* and *C. Grubei*.

CALLIZONA SETOSA (*Greef*), 1885.

Specific Characters.—Head with large dark-brown eyes, situated dorso-laterally and with lenses; four palpi. Body elongated, with sixty-three segments, terminating posteriorly in two thick anal cirri; five tentacular cirri; proboscis with twelve papillæ anteriorly. Anterior feet bearing stout bristles, the terminal pieces of which are thick and serrated; dorsal cirrus foliaceous in front, but posteriorly cirriform; ventral cirrus smaller, leaf-like, becoming more elongated posteriorly.

SYNONYMS.

1880. *Vanadis (Halodora) Petersii*, Langerhans. Zeitschr. f. wiss. Zool., Bd. xxxiii, p. 312.
 1885. „ *setosa*, Greef. Ibid., Bd. xlii, p. 449.
 „ „ *heterochæta*, Viguier. Compt. Rend., t. ci, p. 578.
 1886. „ „ idem. Arch. Zool. Expér., 2 sér., Bd. iv, p. 408.
 1892. *Alciopa cari*, Hering. Sitz. K. Akad. Wiss. Wien, Bd. ci, p. 753.

1900. *Callizona setosa*, Apstein. Plankton Exped., p. 18, Taf. iv, figs. 39—43.
 1911. „ „ Southern. Irish Sc. Invest., No. 3, p. 5.
 1916. „ „ Fauvel. Annél. Pelag. Monaco, p. 69.
 1922. „ „ McIntosh. Ann. Nat. Hist., ser. 9, vol. ix, p. 13.

Habitat.—Captured in the tow-net on eel-trawl near 480 fathoms.

It also has been found in the Mediterranean ; Atlantic, from Africa to Brazil.

CALLIZONA NASUTA, Greef, 1876.

Specific Characters.—Prostomium large and elevated. Frontal tentacles large, brown, and the median placed between the eyes—the region in front and the peristomium being ciliated. Body typical, with five tentacular cirri ; small papillæ on the edge of the proboscis ; last segment yellowish-green ; a single anal cirrus. Foot with pointed leaf-like cirri ; bristles slender, with long, delicate tips, and on the anterior feet one or two thicker bristles. Spermsacs on segments 2—4.

SYNONYMS.

1861. *Rhynchonerella gracilis*, A. Costa. Ann. Mus. Zool. Nap., p. 168, Tav. iv, figs. 13—15.
 1876. *Callizona nasuta*, Greef. Nova Acta K. Leop.-Carol. deut. Akad., p. 72.
 1885. *Rhynchonerella gracilis*, Carus. Fauna Medit., i, p. 246.
 1891. *Callizona nasuta*, Apstein. Jahrb. d. Hbg. wiss. Anst., p. 11.
 1893. „ „ idem. Arch. f. Naturges., p. 148.
 1900. „ „ idem. Plankton Exped., p. 19, Taf. iii, figs. 31 and 32.
 1911. „ „ Southern. Irish Sc. Invest., iii, p. 10.
 1922. „ „ McIntosh. Ann. Nat. Hist., ser. 9, vol. ix, p. 13.

Habitat.—Off the West Coast of Ireland in the midwater trawl between 600 and 700 fathoms (Southern).

Abroad it has been found off the Canary Islands, and off Naples and Messina in the Mediterranean. Southern is of opinion that Apstein's *Callizona Henseni* should be included under this form.

FAMILY HESIONIDÆ.

Genus OXYDROMUS, Grube, 1855.

Cephalic lobe trapezoidal, narrower in front ; two pairs of eyes ; median and two lateral tentacles ; two palpi. Body vermiform, segments comparatively few ; two anal cirri ; buccal segment short ; tentacular cirri four on each side ; long, cylindrical, exsertile proboscis devoid of marginal papillæ ; feet uniramous, conical, with a tuft of slender compound bristles.

OXYDROMUS PROPINQUUS, Marion and Bobretzky, 1875. Plate CXXXIV, figs. 5 and 5a—bristles.

Specific Characters.—Head cordate, and a dimple posteriorly, with groups of vibratile cilia, longer on the lateral and occipital regions ; four eyes in a trapezoid about the middle,

anterior pair being wider apart and with lenses; median tentacle short, the lateral more than twice as long; palpi biarticulate; four tentacular cirri, the largest and longest being the posterior dorsal. Proboscis orange, extending to the fifth bristled segment, series of serrated papillæ anteriorly, and a minutely papillose surface. Body from 6—10 mm. in length, typical in outline, and having posteriorly two long articulated anal cirri and a median process. Pale, with symmetrical brownish bars and two median touches in each segment. Feet well developed, dorsally with a long, articulated dorsal cirrus, and ventrally a shorter cirrus; dorsal setigerous process has two spines and long, simple, slightly curved bristles, with a serrated edge. The ventral bristles have articulated terminal pieces—more or less bifid, and longer dorsally, shorter ventrally. Well-developed eggs in April, and they pass into the feet.

SYNONYMS.

1875. *Gyptis propinqua*, Marion and Bobretzky. Ann. Sc. nat., 2^e sér., t. ii, p. 51, pls. v and vi, fig. 15.
 1888. *Oxydromus propinquus*, De St. Joseph. Ann. Sc. nat., t. v, p. 321.
 1914. „ „ Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 47.
 1915. „ „ Allen. Journ. M. B. A., vol. x, p. 607.
 1921. „ „ McIntosh. Ann. Nat. Hist., ser. 9, vol. viii, p. 298.

Habitat.—In the surface tow-net, as well as on the bottom, Ballynakill Harbour (Southern); dredged near New Grounds Buoy, Plymouth (Allen).

Shores of France and Western Mediterranean in the coralline zone (Marion and Bobretzky), Dinard (De St. Joseph).

The *head* is somewhat cordate in outline, broad posteriorly where the dimple is, nearly straight at the narrower anterior end, and having four eyes in a trapezoid about the middle, the anterior pair being bean-shaped, larger, wider apart, and furnished with lenses. The median tentacle is short and slightly fusiform, the lateral more than twice as long, a little tapered toward the tip, and separated from the rest of the head by a ciliated depression. The palpi have two articulations, a basal and a longer distal. Four tentacular cirri occur on each side, the largest and longest being the posterior dorsal, and in each a nerve is distinct. The proboscis, which has a minutely papillose surface, is of a bright orange hue and extends to the fifth setigerous segment. Anteriorly it has a series of serrated papillæ. It is followed by the intestine, which is constricted at each dissepiment.

The *body* varies in length from 6—10 mm., is typical in outline, and terminates posteriorly in two long articulated anal cirri and a median process. The general aspect is pale, with symmetrical brownish bars and two median touches in each segment. De St. Joseph describes the proboscis as unarmed, and furnished with numerous papillæ at the tip. The feet are well-developed, and, at the reproductive season, the ova pass into them. Dorsally is the long, articulated cirrus, and ventrally the shorter ventral cirrus. At the base of the former is the dorsal setigerous process, having a series of long, simple, slightly curved bristles (Plate CXXXIV, figs. 9 and 9a) with a serrated (spinous) edge, the process being further stiffened by two spines, one of which, curved in the young form, projects amongst the bristles. The ventral series has articulated terminal pieces, more or less bifid, and longer or shorter according to position, the longer dorsal and the shorter ventral.

Reproduction.—At Plymouth, females have well-developed eggs from January to April (Allen), and Southern's example had large ova about the same period. De St. Joseph, again, found that ripe males were greyish, and that when the females were ripe the large grey eggs, which filled the hollows of the feet, were discharged into a thin, colourless membranous pouch.

The foregoing description is chiefly taken from Marion and Bobretzky's account. De St. Joseph found *Ophryodendon annulatorum* on the tentacular cirri. Southern states that it swims gracefully through the water, stops, and even swims backward when its progress is arrested.

Genus MICROPHTHALMUS, *Mecznikow*, 1865.

Head with a single pair of eye-specks devoid of lenses; five unjointed tentacles, and three pairs of tentacular cirri on each side, all smooth. Body like that of *Podarke*, and has a rudimentary dorsal branch to the foot, but it is distinguished from that genus by the presence of only two eyes, and by the flattened posterior extension of the pygidium.

Bobretzky found two hermaphrodite species, *M. fragilis* and *M. similis*, in the Black Sea.

MICROPHTHALMUS SCZELKOWII, *Mecznikow*, 1865. Plate CXXXIV, figs. 6, 6a and 6b—bristles.

Specific Characters.—The head rounded in front, indented posteriorly; single pair of black, kidney-shaped eyes at its posterior part; four slender, tapering tentacles in front, the dorsal slightly longer than the ventral, and all devoid of a basal articulation; median tentacle at the posterior indentation; three pairs of tentacular cirri, somewhat enlarged at the base, on each side. Body widest in the anterior third, tapering slightly anteriorly and more distinctly posteriorly, 6 mm. long, and with forty segments. Lateral regions flattened, leaving a prominent dorsal ridge in the preparations. Dorsum with a considerable amount of brown pigment, forming ill-defined transverse bands in each segment. Anal segment consists of a thickened, deeply pigmented ring, produced backward into a hood-shaped plate, with the anus dorsal at the posterior border of the thickened ridge, which also carries two slender cirri. Proboscis with a series of papillæ anteriorly. Dorsal cirrus of the third segment is the longest appendage. Dorsal cirri twice as long as the ventral.

Dorsal division of the foot carries a single slender spine, and a single small bristle with a pectinate or lyrate tip; ventral division with a single large spine, and a fan-like series of compound bristles with the characteristic Hesionid structure and both longer and shorter tips.

SYNONYMS.

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|-------|---------------------------------|--------------------|---|
| 1865. | <i>Microphthalmus Sczelkowi</i> | <i>Mecznikow</i> . | Zeitschr. f. wiss. Zool., Bd. xv, p. 334, Taf. xxiv, figs. 10—12. |
| 1914. | „ | „ | Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 45, pl. v, figs. 6 a—e. |
| 1921. | „ | „ | McIntosh. Ann. Nat. Hist., ser. 9, vol. viii, p. 299. |

Habitat.—Under a stone in Blacksod Bay (Southern).

Heligoland (Mecznikow).

This is one of the interesting additions made by Southern on the south-western shores of Ireland. The structure generally is that of a Hesionid, but its special features consist in the peculiar lyre-shaped dorsal bristle (Plate CXXXIV, fig. 6), besides the bifid tips of the ventral series (figs. 6*a* and 6*b*), and the hood-like extension of the pygidium. Mecznikow's original description is diagnostic, and he mentions that he found a female with eggs in segments 13 to 24.

CASTALIA FUSCA, *Johnston*.

Two varieties of this species were found by Southern on the west coast of Ireland. The first was dredged in Clew Bay in 24 fathoms, on a bottom of sand and shells, and differed from the ordinary form in having red eyes, the absence of spines on the terminal portions of the bristles, which are shorter and thicker; the terminal pieces tend to be bifid at the tip, and the bevelled end of the shaft is bifid. In the second variety from Ballynakill Harbour the bristles are similar, but longer, the tips of the shafts pointed, not bifid, the terminal pieces are longer, with fine spikes, and the bifid nature of the tip is more distinct. The coarse spikes on the terminal pieces are absent. Further, in a number of segments in the middle of the body the dorsal division has a large curved spine (Southern). Horst¹ gives the extended distribution of this species and the synonymy.

FAMILY SYLLIDÆ.

In this family Caullery and Mesnil² propose to institute a new genus, viz., *Parexogone*, for the *Pædophylax hebes* of Webster and Benedict, which Southern has procured on the west coast of Ireland, the head being formed into a sort of cone with fused palps. The anterior region of the alimentary canal is muscular, with proboscis, crop, and gizzard. The cuticle is thick. The animals frequent compact sand, and the habit for Syllids is thus peculiar. Moreover, an important paper on the group, with excellent illustrations, has recently been published by Prof. Haswell,³ in which both systematic and structural features as well as developmental investigations are detailed. Amongst other interesting structural points, he found that in some the nephridia of each pair unite completely at sexual maturity. In *Exogone fustifera* the extruded egg becomes attached by one end to the area on which the ducts of the pedal gland open—internal to the ventral cirrus. He points out that in *Exogone fustifera* the formation of the coelom differs from that of the Polychæta generally, since the stomodæum ends behind in a mass of tissue (syncytium), in which the large yolk-granules are imbedded. The changes in this take place before the young annelids become free.

In a further paper Haswell⁴ treats of the minute structure of the proboscis of the Syllidæ

¹ 'Zoolog. Mededeelingen,' Deel vi, p. 76, 1921.

² 'Bull. Soc. Zool. France,' xlii, p. 127, 5 figs., 1918.

³ 'Journ. Linn. Soc.,' vol. xxxiv, p. 217, pls. xvii and xviii.

⁴ 'Quart. Journ. Micr. Sci.,' vol. 65, p. 323, pl. xv.

with excellent figures. He describes the buccal cavity, the pharynx, proventriculus, ventriculus and post-ventriculus, the latter resembling the intestine in its ciliated epithelium, but differing in having unicellular glands. He shows that, contrary to the view of Eisig, the muscular tissue of the radial columns in the proventriculus is striated. The fine lines on the organ correspond to the annular bands of non-striated muscular fibres; the dots, which are often coloured in life, are the outer ends of the cores of the radial columns of striated muscle. There is a dorsal and a ventral raphe. Posteriorly the organ has two grooves, with a ridge of thickened epithelium between the plates of opposite sides.

PAREXOGONE HEBES, *Webster and Benedict*, 1887; var. *HIBERNICA*, *Southern*, 1914. Plate CXXXV, fig. 2—bristle; 2a—spine.

Specific Characters.—Head separated from the palpi and buccal segments by faint grooves, and the length exceeds the width. Three tentacles, a long, subulate median, and two small lateral, which are about one-fifth as long as the median. Three pairs of eyes outside the lateral tentacles, and they vary in size; exterior to them are conspicuous, ciliated nuchal organs. Palpi large and fused dorsally, a shallow groove between them ventrally. Brain elongated and bilobed. Buccal segment as large as the head, bearing a pair of small bulbous tentacles with stiff cilia at the tip. The body is about 7 mm. long, with thirty-one bristled segments, somewhat fusiform, creamy white in colour, without other pigment. The proboscis extends from the second to the fifth bristled segment, is covered with dark pigment, except a narrow strip in the fourth segment. Anterior part of proventriculus long and narrow, with twenty rows of points, the succeeding portion being muscular and non-glandular, with two small ciliated sacs. The proboscis has ten soft papillæ anteriorly and a conical tooth. Colour grey or flesh-colour, eyes dark red or black.

SYNONYMS.

1887. *Pædophylax hebes*, Webster and Benedict, U.S. Com. F. and F., p. 716, pl. iii, figs. 31—36.
 1914. *Exogone* „ var. *hibernica*, Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 17.
 1918. *Parexogone* „ Caullery and Mesnil. Bull. Soc. Zool. France, xlii, p. 127, 5 figs.
 1921. „ „ McIntosh. Ann. Nat. Hist., ser. 9, vol. viii, p. 300.

Habitat.—Blacksod, Galway and Clew Bays, Lough Swilly and the coast of Kerry, both between tide-marks, and dredged in 78 fms. (Southern). It is partial to a bottom of sand and shells.

Distribution.—Provincetown, Mass.; Eastport, Maine (Webster and Benedict). Caullery and Mesnil found it living in compact sand on the shores of France.

A minute but typical Syllid, the feet armed with bristles of moderate length. The body is tapered more posteriorly than anteriorly, ending in a sharply conical tail. The foot has an unequally bilobed setigerous process, the dorsal portion with the spine (Plate CXXXV, fig. 2a) being the smaller and having a rounded papilla near the tip. Dorsal cirrus small and bulbous, with stiff cilia distally. Bristles in a fan-shaped series. Shafts curved, swollen and bevelled at the tip; terminal pieces coarsely spinous proximally, and some distance below the tip is a broad tooth (Plate CXXXV, fig. 2). A single spine is present,

its tip being enlarged and smooth (Plate CXXXV, fig. 2*a*). A simple dorsal bristle appears in the seventh foot, and is joined in the posterior seven segments by a similar ventral bristle, this type being curved and pointed with a spur at the base as in various Syllids. A female in May had two ova in each segment from the tenth to the twenty-second (Southern).

GRUBEA LIMBATA, *Claparède*, 1868. Plate CXXXV, fig. 4—head and anterior region; fig. 4*a*—bristles.

Specific Characters.—Head has four large eyes with lenses, the anterior pair wider apart; tentacles slightly fusiform. Buccal segment not distinct on the dorsum, but conspicuous ventrally. Body pale, 3 mm. in length, and having in mature examples twenty-seven segments. Dorsal cirri of the second segment not longer than the others. Proboscis straight, with a crenulate lateral margin, the striated pigment of the organ having a transverse pale band, and the pigmented central region being separate from the pale lateral. Compound bristles with simple, slightly hooked terminal pieces.

SYNONYMS.

1868. *Grubea limbata*, Claparède. *Annél. Nap.*, p. 208, pl. xiii, fig. 4.
 1879. „ „ Langerhans. *Zeitschr. f. wiss. Zool.*, Bd. xxxii, p. 566.
 1884. „ „ Vignier. *Arch. Zool. Expér.*, t. ii, p. 103.
 1915. „ „ Allen. *Journ. M. B. A.*, vol. x, p. 598.
 1921. „ „ McIntosh. *Ann. Nat. Hist.*, ser. 9, vol. viii, p. 301.

Habitat.—Amongst laminarian roots at low water, and dredged in 4—5 fathoms at Plymouth (Allen).

Abroad it occurs at Naples (Claparède).

The *head* (Plate CXXXV, fig. 4) has a similar arrangement of the tentacles to that in *G. clavata*, the two lateral being anterior, the median posterior, and they are somewhat fusiform, the base being enlarged, whilst the distal region is tapered. Four large brownish eyes occur posteriorly, the anterior being wider apart, and all have lenses. The proboscis occupies segments 2—5, and has no denticulations on the anterior rim, but the lateral walls are crenulate. The pigmented layer is marked by a pale ring as in *G. tenuicirrata*, and the organ presents a glandular appearance. The proventriculus is in segments 6—8, and has twenty rows of dots; its anterior part seems as if clothed with a horny coat, which may be a continuation of the proboscidian tissue. The stomach is in segment 9, and has a pair of glandular pouches. The chloragogenous intestine follows. The compound bristles (Plate CXXXV, fig. 4*a*) have rather short, slightly hooked terminal pieces.

Reproduction.—In an adult male Claparède noticed seventeen pairs of long swimming-bristles, the first on the ninth segment, the last on the penultimate. The extruded ova are carried on the dorsal cirri in pairs. In the dorsal position of the ova it agrees with *Syllides*. *Exogone* and *Sphaerosyllis* carry them ventrally. Recently Caullery and Mesnil¹ have found in this species a sexual stolon and schizogony.

¹ ‘Bull. Soc. Zool. France,’ xliii, pp. 34—40, w. figs.

GRUBEA PUSILLA, *Dujardin*, 1851. Plate CXXXV, fig. 5—head and anterior region.

Specific Characters.—Head with long, soldered palps; lateral tentacles toward the anterior part of the head, median in front of the posterior border, all enlarged toward the base, tapered distally. Eyes four, anterior pair wider apart, and all with lenses. Body 2—5 mm. long, pale; segments twenty-eight to thirty-four. Buccal segment showing on the dorsum. Dorsal cirri somewhat truncated distally, and with bacillary bodies internally, opaque brownish. Two anal cirri and an appendix. Pharynx (proboscis) yellowish brown with a pale ring; tooth some distance behind the anterior border; intestine dull greenish. Proventriculus with fifteen rows of points. Bristles with long, simple, distal pieces hooked at the tip, bidentate, and spinous on the edge below, those with the longer tips absent in the last segments. Both ventrally and dorsally is a simple bristle, slightly hooked at the tip—dorsally from the fifth foot in front, ventrally only in the last three segments.

SYNONYMS.

1851. *Exogone pusilla*, Dujardin. Ann. Sc. nat., 3^{me} ser., t. xv, p. 299, pl. v, figs. 9 and 10.
 1864. *Sphærosyllis pusilla*, Claparède. Glanures, p. 89, pl. vi, fig. 3.
 1865. *Brania pusilla*, De Quatrefages. Annel., t. ii, p. 18.
 1868. *Grubea* „ Claparède. Annél. Nap., p. 207.
 1874. „ „ Marenzeller. Sitzb. K. Akad. Wiss. Wien, Bd. lxix, p. 451.
 1879. *Brania* „ Langerhans. Zeitschr. f. wiss. Zool., Bd. xxxii, p. 565.
 1886. *Grubea* „ De St. Joseph. Ann. Sc. nat., 7^e sér., t. i, p. 203, pl. x, figs. 77—78.
 1914. „ „ Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 22.
 1915. „ „ Allen. Journ. M. B. A., vol. x, p. 298.
 1921. „ „ McIntosh. Ann. Nat. Hist., ser. 9, vol. viii, p. 201.

Habitat.—Blacksod and Clew Bays, and at Clare Island on seaweeds, Laminarian roots, and amongst Lithothamnion on shore, and to a depth of 16 fathoms; surface tow-net at night in Ballynakill Harbour (Southern). Common amongst Laminarian roots from Rum Bay, Plymouth (Allen).

Distribution.—St. Malo (Dujardin); Baltic (Ersted). Amongst Fuci, shores of France and Laminariæ, Port Vendres, Normandy (Claparède); Dinard, where it is less common in the dredge than *G. clavata* (De St. Joseph). The Canaries (Langerhans); Mediterranean.

The head (Plate CXXXV, fig. 5) has long, soldered palps; lateral tentacles toward the anterior border, the longer median in front of the posterior border, all having the fusiform enlargement at the base, whilst they are tapered distally. The four eyes are furnished with lenses, and the anterior are wider apart. There are four tentacular cirri. The proboscis is smooth, with a tooth near anterior end. The body is about 2—5 mm. in length, and has from twenty-eight to thirty-four segments. Posteriorly Langerhans describes an unpaired median appendix between the anal cirri. Feet with the fusiform dorsal cirri truncated, with bacilli in the interior. Ventral cirri filiform, short, the ventral bristles have long, simple terminal pieces, bidentate, and with spines along the margin distally.

Reproduction.—Ripe females were found by Dujardin, Marenzeller and Langerhans, the latter stating that in one with thirty segments two eggs occurred in each segment from the eleventh to the twenty-second. De St. Joseph (1886) mentions that the males have

swimming-bristles and sperms, whereas the females are devoid of swimming-bristles, and carry two eggs ventrally on segments 10–26. But he has also met with one devoid of swimming-bristles carrying embryos on the dorsum from the tenth to the fifteenth segment (six segments). Usually they are fixed by their anal segment to the ventral surface of the parent, near the ventral cirrus, and so placed that their dorsal surfaces are in keeping with that of the mother. They have four eyes in a line, three tentacles, four tentacular cirri on the buccal segment, rudiments of proboscis and proventriculus, whilst a mass of orange yolk occupies the position of the intestine. There are four setigerous segments and the anal has two small cirri. The dorsal cirri have the truncated form of the adult, but contain no bacillary bodies, and they are absent from the second setigerous segment, thus differing from the adult. The minute ventral cirri are present on four segments. The palpi, longer than the head, are less attenuate in front than in the adult. He further notes, as a distinction between this species and *G. clavata*, that the embryos are developed in eggs on the dorsum of the parent, whence they escape when sufficiently advanced; whereas in *G. pusilla* they are developed on the ventral surface of the mother, to which they remain adherent after leaving the egg. He adds a caution, however, that possibly variations occur in both.

Prof. Haswell has found a hermaphrodite condition of the species in Australia (Port Jackson), for one or two male segments are followed by a number of female ones, thus resembling such Serpulids as *Filograna*. In *G. quadrioculata* he found the ova attached dorsally between the cirrus and the foot. Mr. Southern met with a mature male in March, whilst specimens with embryos attached occurred in May.

SPHÆROSYLLIS ERINACEUS, *Claparède*, 1863. Plate CXXXV, figs. 6 and 6a—bristles.

Specific Characters.—Head comparatively large, fused with the buccal segment, and with large connate palps. Median tentacle behind the transverse line of the four large eyes with lenses, whilst in front are two ocular specks, the three forming a triangle on each side. A pair of tentacles indicate the fused first segment. Palpi short and adpressed. Median and lateral tentacles with enlarged bases. Body 1.40 mm. to 2 mm. long, colourless, and composed of about twenty-two bristled segments, the surface covered with numerous papillæ. The dorsal cirri are enlarged at the base and pointed distally, and the anal cirri have a similar shape (Allen), though De St. Joseph states they are not enlarged at the base. Pharynx with a tooth in front; proventriculus with seventeen rows of points, and a stomach with small lateral pouches. Posterior end short, more tapered than the anterior. Dorsal bristles simple, curved, slightly hooked at the tip. Ventral bristles with longer terminal pieces than in *S. hystrix*. Capillary bristles commence on the eighth and occur on eleven segments. A simple curved bristle present in all the feet. Terminal pieces of the bristles longer than in *S. hystrix*. Spines blunt or slightly enlarged at the tip, but not curved as in the bristles (Southern). Four ova on each segment, from the ninth to the eighteenth.

SYNONYMS.

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| 1863. | <i>Sphærosyllis erinaceus</i> , | Claparède. | Beobach., p. 45, Taf. xiii, fig. 38. |
| 1886. | „ | „ | De St. Joseph. Ann. Sc. nat., 7 ^e ser., t. i, p. 207, pl. x, figs. 81–83. |
| 1914. | „ | „ | Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 20. |

1915. *Sphærosyllis erinaceus*, Allen. Journ. M. B. A., n.s., vol. x, p. 597.
 1918. „ „ Mesnil and Caullery. Bull. Soc. Zool. France, xliii, p. 36.
 1920. „ „ Haswell. Journ. Linn. Soc., vol. xxxiv, p. 224.
 1921. „ „ McIntosh. Ann. Nat. Hist., ser. 9, vol. viii, p. 302.

De St. Joseph found a single ripe female 1·40 mm. long at Dinard at the depth of 26 mètres. There were twenty-two setigerous segments. The median tentacle arises in a line with the posterior eyes. A single pair of tentacles occurs on the achetous segment fused with the head. The eyes agreed with the type, and so with the dorsal and anal cirri. No dorsal cirri on the second setigerous segment. The bristles, which in the ordinary form have the structure represented in Plate CXXXV, figs. 6 and 6*a*, have long tips, with a simple extremity, long and pectinate. At the seventh segment is a simple dorsal bristle. Seventeen rows of points (“*points gris*”) occur on the proventriculus; stomach with lateral pouches. From the ninth to the eighteenth segment four eggs in each, but no swimming-bristles. He doubts if the form of Langerhans is the same, since it differs in the palps, which are higher, and in the position of the tooth in the pharynx, which is in the middle. Moreover, the bristles differ in structure, though it must be said that neither is drawn with sufficient detail. The number of eggs in each segment also differs. There is perhaps room for doubt as to the separation of some of these minute forms—even though they are apparently mature.

Recently MM. Caullery and Mesnil¹ have found at the Hogue a species of *Rhopalocera* in this form.

SPHÆROSYLLIS BULBOSA, *Southern*, 1914. Plate CXXXV, figs. 7 and 7*a*—bristles.

Specific Characters.—Head oblong, with rounded corners; eyes four, large, with lenses; tentacles, tentacular cirri and dorsal cirri as in *S. hystrix*. Palps long and broad, fused, with a faint dorsal furrow, but a conspicuous ventral groove. Nuchal organs in lateral region between head and peristomium. Body 5—6 mm. long, and having forty-eight setigerous segments, widest in the anterior third and tapering toward each end. No papillæ on body, except on the feet and anal segment, which has two cylindrical cirri, with slightly swollen bases. Bristles with short terminal pieces; dorsally a single stout spine curved and sloped at the tip. Compound setæ few (four in each as a rule), spines stout with a bulbous tip and a small process at the end (thus differing from *S. hystrix*). Proboscis has a bluntly rounded tooth in front and a crown of soft papillæ; proventriculus has fourteen rows of points.

SYNONYMS.

1914. *Sphærosyllis bulbosa*, Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 20, pls. i and ii, figs. 2 A—G.
 1920. „ „ McIntosh. Ann. Nat. Hist., ser. 9, vol. viii, p. 303.

Habitat.—Dredged in numbers in Clew Bay in 24—27 fathoms, and other parts on the West Coast of Ireland (Southern).

This species is distinguished by the absence of papillæ on the body, the short terminal

¹ ‘Bull. Soc. Zool. France,’ 1918.

pieces of the bristles, the structure of the simple bristles and spines, and the well-developed buccal segment. It is near *Sphærosyllis Claparèdii*, Ehlers, but in the latter the buccal segment is fused with the head, and no papillæ occur on the feet or on the anal segment (Southern). The bristles are shown in Plate CXXXV, figs. 7 and 7a.

SPHÆROSYLLIS OVIGERA, *Langerhans*, 1879. Plate CXXXV, fig. 9—head and anterior region (after Langerhans).

Specific Characters.—Head with four large eyes, posterior pair nearer each other, anterior a little in front. Three tentacles in a transverse line. Median tentacle in a line with or in front of the anterior eyes. Body about 1.5 mm. long; segments twenty-four to twenty-eight, beset with papillæ and encrusted with mud. Dorsal cirri with enlarged bases and almost pear-shaped. Pharynx with a tooth anteriorly; proventriculus with ten rows of dots; two thick anal cirri. Dorsal bristles simple, slightly bent at the tip. Terminal process of ventral bristles somewhat long, with curved ends and spikes. End of shaft dilated, with a process in front.

SYNONYMS.

1879. *Sphærosyllis ovigera*, Langerhans. Zeitschr. f. wiss. Zool., Bd. xxxii, p. 567, Taf. xxxii, fig. 23.
 1915. „ „ Allen. Journ. M. B. A., vol. x, p. 597.
 1921. „ „ McIntosh. Ann. Nat. Hist., ser. 9, vol. viii, p. 303.

Habitat.—Dredged in Plymouth Sound, near New Grounds Buoy (Allen).

Abroad it ranges to Madeira (Langerhans), where it occurs amongst algæ between tide-marks.

In this form the head (Plate CXXXV, fig. 9) has four large eyes, the posterior pair nearer each other, the anterior a little in front. The three tentacles are in a transverse line, the median often in front of the anterior eyes. The palpi are broad and flattened. The body is about 1.5 mm. in length, and the mature form has from twenty-four to twenty-eight segments, the surface being beset with papillæ and encrusted with sand and mud—a feature which enabled Dr. Allen to separate it from *S. hystrix* found along with it. The dorsal cirri are short, with enlarged bases so as almost to be pear-shaped, and there are two thick anal cirri. The pharynx has a tooth anteriorly and the proventriculus has ten rows of dots. The dorsal bristles are simple, slightly curved at the tip. The terminal process of the ventral bristles is somewhat long, with a curved end and spikes; moreover, the end of the shaft is dilated, with a process in front.

Langerhans found two males with swimming-bristles and sperms. A female carried eggs on segments 12—15, whilst another had on its ventral cirri either ova or embryos. The females had no swimming-bristles. He thought that it approached *S. pirifera* and *S. hystrix*, but the great size of the palpi and the shape of the median tentacle are characteristic.

This species is entered in the list from Plymouth, but some uncertainty exists, though it may yet be found on the southern coasts. As mentioned on p. 159 of vol. ii, Part I, of the monograph, Dr. Allen's preparation showed that the structure of the foot, the presence of a single slightly curved and pointed bristle and the structure of the compound bristles all agree with *S. hystrix*. The example from Plymouth did not show the spine on the enlarged terminal region of the shaft as figured by Langerhans.

PIONOSYLLIS SERRATA, *Southern*, 1914. Plate CXXXV, fig. 10—bristle.

Specific Characters.—Head rounded in front, straight behind; six eyes, the anterior mere specks at the bases of the lateral tentacles, the middle large with the lenses directed forward, the posterior nearer each other and the lenses directed backward. Median tentacle arises in front of the eyes; lateral tentacles spring from the anterior margin. Palps ventral, fused at the base. Tentacles smooth and cylindrical, jointed at the base. Body minute, 2.5 to 3 mm. long, with twenty-seven setigerous segments, which are widest at the tenth. It tapers posteriorly, the anal segment rounded and furnished with two slender subulate cirri. Buccal segment invisible from the dorsum, being covered by the first setigerous segment. It bears a pair of tentacular cirri on each side, the dorsal pair being the longer, and like the tentacles smooth and cylindrical. The dorsal cirri of the first setigerous segment, which projects forward alongside the head, are the longest of all the appendages. In the anterior and posterior segments the ventral cirri extend beyond the setigerous lobes, but in the middle they are equal or slightly shorter. Foot with a bluntly pointed setigerous lobe, bearing a small dorsal papilla at the tip, so that it seems slightly bifid from above; ventral cirrus broad and pointed. The bristles form a fan-shaped series; ends of the shafts swollen and bevelled, with conspicuous spines, the upper with long terminal pieces having four or five long slender teeth inferiorly; tip boldly hooked, the process beneath almost vertical. ventral bristles simply hooked, and the margin is smooth or very faintly spinous. Of the sixteen bristles in each foot five to seven of the dorsal are bifid, the rest simple. Each foot has one spine except the first, which has two, tapering distally and with a bulbous tip. In the six posterior segments is a long capillary bristle dorsally.

SYNONYMS.

1914. *Pionosyllis serrata*, Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 23, pls. iii and iv, figs. 5 A—E.
 1921. „ „ McIntosh. Ann. Nat. Hist., ser. 9, vol. viii, p. 305.

Habitat.—Between tide-marks, Blacksod Bay, Bofin Harbour, 1—4 fathoms, Ballynakill Harbour 2—8 fathoms, midwater net off Cleggan Head at 7 fathoms, and in the surface net off Inishturk (Southern).

This form, according to Southern, is closely related to *Pionosyllis pulligera*, Krohn, differing, however, in so far as the buccal segment is visible dorsally; the proventriculus extends only into two segments, and the spine and the bristles (Plate CXXXV, fig. 10) differ. The lateral tentacles are also shorter.

As in the other minute forms further investigation may show different relationships.

Syllis (Typosyllis) variegata, Grube, again, which Southern distinguishes from *P. prolifera* by its colour-pattern, has the tips of bristles less boldly bifid, and the edge more serrate; whilst the spines in the posterior feet are very thick and bluntly pointed, especially in young specimens. This is a widely distributed species, ranging to Australia (Haswell) and elsewhere.

Genus STREPTOSYLLIS, Webster & Benedict, 1887.

Syllidæ with three tentacles; four tentacular cirri; palpi fused at the base, filiform at the tip; cirri smooth or indistinctly moniliform. Proboscis unarmed; feet in a variable

number of the anterior segments, with thicker spines, shorter and thicker bristles, and shorter terminal pieces; simple bristles dorsally; ends of the shafts presenting several teeth; ventral cirri long in the posterior segments. Reproduction direct, with a pelagic stage.

STREPTOSYLLIS WEBSTERI, *Southern*, 1914. Plate CXXXV, fig. 12—head and anterior region; 12a—bristles.

Specific Characters.—Head broader behind than in front; eyes four, large, rounded, reddish brown, with lenses; median tentacle absent; lateral tentacles spring from the front of the head, smooth and cylindrical, slightly narrowed at the base; palps small and filiform, ventral. Ciliated nuchal organ between the head and the buccal segment, the latter having a pair of smooth tentacular cirri on each side, longer than the lateral tentacles, but shorter than the anterior dorsal cirri. All the cirri have rounded, faintly yellow granules internally. Body 3—5 mm. long, and having thirty-two to forty-nine segments; proboscis straight and broad, dark reddish-brown, unarmed, and occupies three to four segments. Proventriculus extends over four to five segments, and has about fifty rows of dots. The anal segment bears a median, and two short lateral cirri.

SYNONYMS.

1914. *Streptosyllis Websteri*, *Southern*. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 26, pl. ii, figs. 3 A—F.

1921. „ „ McIntosh. Ann. Nat. Hist., ser. 9, vol. viii, p. 305.

Habitat.—Ballynakill and Bofin Harbours, in bottom tow-net (*Southern*).

The *head* (Plate CXXXV, fig. 12) has the outline indicated in the specific characters. Feet prominent, five characterising the anterior region, the spine in the first segment being thin, as in the posterior segments. In segments 2—5 the spines are large and thick. A single simple bristle is present in the dorsal region throughout. At the sixteenth foot the setigerous lobe is smaller, but the ventral cirrus is longer than in the anterior region. Bristles (Plate CXXXV, fig. 12a) in segments 1—5 shorter and thicker than in the others. Behind these the bristles are thinner, have serrate terminal pieces, and the end of the shaft is serrated on one edge and has four sharp lobes, whilst the spine is slender with a bulbous tip. Capillary bristles begin at the 11th segment and extend almost to the tip of the tail in the mature males (the only forms found).

Southern states that this species is most closely allied to *S. varians*, De St. Joseph. It resembles it in having five setigerous segments in the anterior region, and in having simple tips to the compound bristles. It differs in the presence of a slender spine in the first setigerous segment, in the shape of the terminal pieces of the anterior bristles, in the occurrence of simple dorsal bristles in all the segments, in having three anal cirri, and in other details. These differences, however, require further investigation.

STREPTOSYLLIS BIDENTATA, *Southern*, 1914. Plate CXXXVII, fig. 3—foot with bristles.

Specific Characters.—Head broad, the width exceeding the length; four large eyes with lenses, the median tentacle arising between the anterior pair; palps ventral, invisible

from above, their bases fused with the head and their tips having slender papillæ. Nuchal organs between the head and the buccal segment, which is distinct from the head and bears two pairs of smooth tentacular cirri. Body 2—5 mm. long; segments twenty-three to thirty-one or more; widest in the proventricular region, tapering slightly toward the head and more distinctly posteriorly. Anal segment with a short slender median, and two short lateral cirri. Proboscis short, straight and broad; proventriculus is massive, extends over six segments, and has forty-eight rows of dots. Feet prominent, with a patch of cilia above each, and the six anterior segments differ from those behind. Dorsal cirri of all are long, cylindrical and smooth; ventral cirri long and spring from the extremity of the setigerous lobe, which is blunt, with two thick spines. Dorsally is a simple bristle, curved distally and winged. Compound bristles short, thick, the ends of the shafts having three or four blunt teeth, the terminal pieces are bifid and coarsely serrated. The setigerous lobe and the bristles vary posteriorly, being more slender. A mature example carried ova from the twelfth segment.

SYNONYMS.

1914. *Streptosyllis bidentata*, Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 28, pl. iii, figs. 4 A—F.
 1921. „ „ McIntosh. Ann. Nat. Hist., ser. 9, vol. viii, p. 306.

Habitat.—Dredged in 24 fathoms in Clew Bay, on a bottom of sand and shells.

The structure of the simple, serrated winged bristle recalls that of *Staurocephalus*. The species differs from *S. varians* in the length of the proboscis and proventriculus, in the moniliform condition of some of the dorsal cirri, in the larger palps, in the minute structure of the bristles, and in the greater number of the anterior segments with thick spines. It differs from *S. Websteri* in having six segments in the anterior region and in the structure of the bristles (Southern). The foot (Plate CXXXVII, fig. 3) has dorsally a simple bristle curved distally and winged. The compound bristles are short, with three or four blunt teeth at the end of the shaft, the distal piece being bifid and coarsely serrated.

Genus OPISTHODONTA, *Langerhans*, 1879.

Palps separate; single tooth behind middle of proboscis; smooth unjointed cirri and tentacles. Reproduction direct.

OPISTHODONTA PTEROCHÆTA, *Southern*, 1914. Plate CXXXVII, fig. 4—foot and bristles.

Specific Characters.—Head rounded in front; four large reddish eyes with lenses; median tentacle absent, arises between the anterior eyes; lateral tentacles near front margin; palps free distally, united at the base. Buccal segment distinct dorsally, with two pairs of tentacular cirri, the dorsal twice the length of the lateral tentacles. All tentacles and cirri smooth and cylindrical. Body fragmentary, 6 mm., with forty-nine segments, tapered anteriorly. Pharynx dark brown, stretching through sixteen segments, and bears a sharp lateral tooth behind its middle. Proventriculus long and cylindrical, occupying eleven

segments; forty-five rows of dots—joined by wavy lines; passes into wide stomach with two diverticula in front. Anterior feet with bluntly rounded, bifid setigerous lobes; ventral cirrus massive, swollen at the base; thirteenth segment has a fan-like series of bristles with curved shafts, the ends of which are enlarged and spinous; distal pieces with simple curved tips; spines large and thick, with swollen truncated tips. From the sixteenth segment they are replaced by slender spines. Capillary swimming-bristles on thirty-first foot. In the middle region of the body foot biramous, the dorsal division having a tuft of capillary bristles, and a slender spine with a blunt and rounded tip; ventral division with a single upper winged bristle; four or five compound and a single simple bristle without wings below. Resembles *O. morena*, Langerhans, but differs in the structure of the simple winged bristles, and the thick spines of the anterior segments approach closely those of *Streptosyllis*, which, however, has an unarmed proboscis.

SYNONYMS.

1914. *Opisthodonta pterochæta*, Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 30, pl. iv, figs. 6 A—G.
 1921. „ „ McIntosh. Ann. Nat. Hist., ser. 9, vol. viii, p. 306.

Habitat.—Procured in the midwater tow-net off Cleggan Head, Co. Galway, in October (Southern).

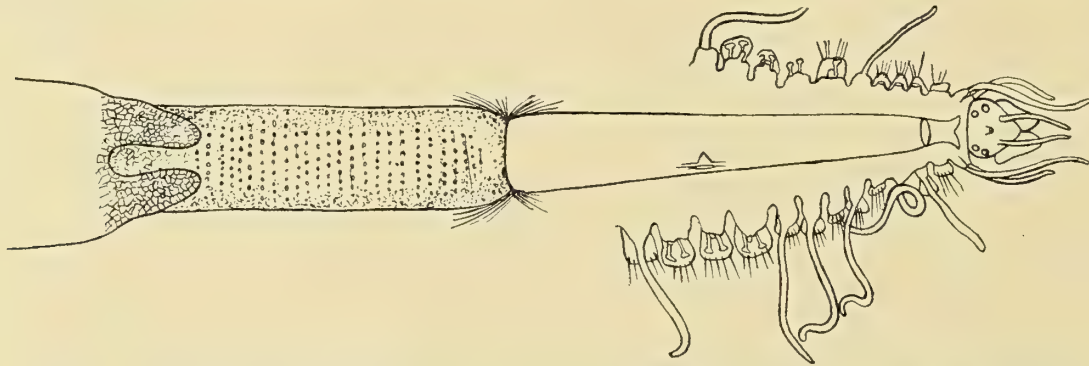


FIG. 171.—Anterior region of *Opisthodonta pterochæta* showing the tooth about the middle of the pharynx.
 × 42. After Southern.

In this form, an imperfect male of which was obtained in July, the sharp tooth is situated behind the middle of the pharynx. Capillary swimming-bristles commence on the thirty-first segment. In the middle region of the body the foot is biramous, the dorsal division having a tuft of long capillary bristles and a slender spine with a bluntly rounded tip. Development is probably direct (Southern). The thirteenth foot is shown in Plate CXXXVII, fig. 4.

SYLLIS (EHLERSIA) FERRUGINEA, *Langerhans*, 1881. Plate CXXXVIII, fig. 7—tips of bristles.

Specific Characters.—Head with broad palpi; four large posterior eyes, and two smaller anterior; tentacles with seventeen to twenty-five segments; tentacular cirri seventeen to twenty-four segments. Body of immature example 1.0 cm. long, with seventy segments, reddish, with greenish intestine. Dorsal cirri of the second segment with thirty articulations,

and longer than the others. Dorsal cirri alternately long and short, and behind the first few segments they are smooth. Bristles of two kinds, either short bidentate tips, or with long, slender, tapering tips. Mature in March.

SYNONYMS.

1881. *Ehlersia ferruginea*, Langerhans. Nova Acta Ksl.-Carol. Deutscher Akad., Bd. xlii, Halle, p. 104, Taf. iv, fig. 10 *a, b*.
 1914. *Syllis (Ehlersia) ferruginea*, Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 38.
 1921. *Ehlersia ferruginea*, McIntosh. Ann. Nat. Hist., ser. 9, vol. viii, p. 306.

Habitat.—Blacksod Bay in Laminarian roots (Southern). Abroad it occurs at Madeira (Langerhans).

Southern found a mature female in March, with a long tuft of swimming-bristles on the twenty-eighth segment, and no sign of a bud, so that it probably reproduces directly, and may pertain to *Pionosyllis lamelligera*, De St. Joseph. It differs from *Syllis cornuta*, Rathke, in having smooth dorsal cirri, and in the structure of the bristles, which, however, diverge very little from those of *E. cornuta*, Rathke. The figures of Langerhans, representing the bristles of the second and twenty-third segments (Plate CXXXVIII, fig. 7), are the only ones available.

EUSYLLIS LAMELLIGERA, Marion & Bobretzky, 1875. Plate CXXXVII, figs. 5 and 5*a*—head and bristles.

Specific Characters.—Head somewhat circular, with cilia along its posterior border; eyes three pairs, all with lenses, the anterior pair smallest, the middle the largest. Palpi considerably developed, soldered at the base. Median tentacle long and robust; lateral shorter; tentacular cirri well developed. Body similar to that of *E. Blomstrandii*, 10—15 mm. long, and having about fifty-three segments. Proboscis with a dorsal stylet and two glandular tubes; proventriculus with twenty-two rows of violet points, and occupying segments 8 to 10. First ventral cirrus lamellar. Dorsal cirri alternately long and short. The violet ova or the sperms appear in the twelfth and following segments, twenty of which have swimming-bristles. Coloration dull grey, the tips of the tentacles brownish, the proboscis brown, the proventriculus violet, the intestine greenish, becoming colourless in the terminal segments (De St. Joseph).

SYNONYMS.

1875. *Eusyllis lamelligera*, Marion and Bobretzky. Ann. des Sc. nat., 6^e sér., t. ii, p. 33, pl. iii, fig. 9.
 „ „ „ Marion. Compt. Rend., t. lxxx, p. 498.
 1886. „ „ De St. Joseph. Ann. Sc. nat., 7^e sér., t. i, p. 169.
 1915. „ „ Allen. Journ. M. B. A., n.s., vol. x, p. 599.
 1922. „ „ McIntosh. Ann. Nat. Hist., ser. 9, vol. viii, p. 307.

Habitat.—Dredged on Mewstone Ledge and Eddystone Grounds, Plymouth (Allen).

Elsewhere it occurs in the Mediterranean (Marion and Bobretzky), and at Dinard, France (De St. Joseph).

Allen observes that it is a well-defined species, distinguished by the enlarged and leaf-

like shape of the first ventral cirri. He dredged a female with nearly ripe eggs in July on Mewstone Ledge, Plymouth. Marion and Bobretzky procured a ripe male in January, without swimming-bristles. They consider that though it approaches *E. Blomstrandii* in the non-moniliform dorsal cirri, in the fusion of the palpi at the base, and in the presence of six distinct eyes on the head, it is different (Plate CXXXVII, fig. 5). The first dorsal cirrus is long, and the first ventral cirrus is foliaceous. The bristles (Plate CXXXVII, fig. 5a), moreover, differ. No example has been seen by the writer, but Dr. Allen intends to publish an account of this and other forms he has recently procured.

EUSYLLIS MONILICORNIS, *Malmgren*, 1867. Plate CXXXV, fig. 13—head and anterior region.

Specific Characters.—Head with six eyes, two small, the first segment forming a pad behind it. Tentacles indistinctly articulated, but in contraction moniliform. Palpi rather long, but fused at the base. Body comparatively large, 10—15 mm. long, and having fifty-two to sixty-seven segments. Dorsal cirri of the second and fifth segments longer than the following, which are unequal amongst themselves. Proboscis in segments 2—6, without lateral pouches, and with its crown of papillæ little developed; a large dorsal stylet with a poison-canal, and a transverse brown bar a short distance from the proventriculus, as well as one in front. Proventriculus with sixty-five to eighty rows of points (De St. Joseph) in segments 7—11. Stomach with two lateral pouches, of a brownish colour like the intestine, ciliated internally. Sexual elements in segments 16—52 with swimming-bristles. Ripe examples have two orange segmental organs in the form of curved tubes from the fifteenth segment. Feet show two kinds of bristles, viz. those with short and those with long tips. First segment with a single spine; the following twenty-nine have three—one a large crochet, and two with button-like tips. The thirteen succeeding have only a hooked spine, which in the last twelve is accompanied by compound bristles, a simple capillary bristle and a bifid bristle. The general coloration is pale orange, the hind part of the head having a patch of dark brown or black pigment.

Langerhans procured ripe examples from October to January, the eggs being brownish-yellow. The males had swimming-bristles at the twentieth segment and the females at the sixteenth.

SYNONYMS.

1867. *Eusyllis monilicornis*, Malmgren. Annul. Polych., p. 41, Tab. vi, fig. 44.
 1875. „ „ Marion. Compt. rend., t. lxxx, p. 498.
 „ „ „ idem. Revue des sc. nat., t. iv, p. 305, pl. vi, figs. 1—3.
 „ „ *assimilis*, Marenzeller. Sitzb. K. Akad. wiss. Wien, 2 Beitr., p. 30, pl. iii, fig. 2.
 1879. „ *monilicornis*, Langerhans. Zeitschr. f. wiss. Zool., Bd. xxxii, p. 551, pl. xxxii, fig. 13.
 1883. „ „ Levinsen. Vid. Meddel. naturh. Forhandl. Copenhagen, p. 245.
 1893. „ „ Malaquin. Recher. Syllid., pp. 79 *et seq.*, pls. ii *et seq.*
 1894. „ „ Bidentkap. Christiania Vidensk.-selsk. Forhandl., p. 90.
 1914. „ „ Fauvel. Camp. Sc., p. 104.
 1915. „ „ Allen. Journ. M. B. A., n.s., vol. x, p. 599.
 1921. „ „ McIntosh. Ann. Nat. Hist., ser. 9, vol. viii, p. 307.

Habitat.—Dredged in Plymouth Sound (Allen).

Occurs at Spitzbergen (Malmgren); coast of France, Dinard (De St. Joseph); Marseilles (Marion); Adriatic (Marenzeller); Madeira (Langerhans).

De St. Joseph found *Trichodina auerbachii* on the appendages.

The species (Plate CXXXV, fig. 13, head) is apparently more common in the south than in the north. De St. Joseph observed segmental organs of an orange colour in each segment after the fifteenth. He describes two kinds of bifid bristles, viz., those with short and those with long tips. The dorsal cirri of the second and fifth segments are longer than the following, which are unequal amongst themselves.

AUTOLYTUS MACROPHTHALMUS, *Marenzeller*, 1875. Plate CXXXV, fig. 15—head and anterior region; 15a—b—anterior and posterior bristles.

Specific Characters.—The head is distinguished by the large size of the four eyes, which cover a considerable portion of the surface, occasionally with a few additional specks. The tentacles are long, and the median exceeds the lateral. The palps are ciliated ventrally. Body 8—20 mm. in length, and with sixty-seven to eighty segments, and is terminated posteriorly with two rather thick anal cirri. The proboscis makes a single convolution, and has anteriorly sixteen to twenty nearly equal soft papillæ provided with palpcils. Its anterior muscular fibres are well developed. The violet or reddish proventriculus is barrel-shaped and occupies segments 8—10 or more when elongated, and has thirty-eight to forty-four rows of violet points. The intestine anteriorly (hepatic, De St. Joseph) and posteriorly (urinary, idem) has in its walls concretions which disappear with effervescence on adding nitric acid. Bristles correspond with those of the type; in the thirty-nine posterior segments there is an awl-shaped process at the joint. Develops directly, eggs being red, or by stolons. Colour of body light orange, tips of tentacles orange.

SYNONYMS.

1876. *Proceræa macrophthalma*, Marenzeller. Sitzb. der K. Akad. Wien, Bd. lxxi, sep. abdr., p. 165, pl. iv, fig. 2.
 1879. „ „ Langerhans. Zeitschr. f. wiss. Zool., Bd. xxxii, p. 579, pl. xxxii, fig. 29.
 1886. *Autolytus (Proceræa) macrophthalma*, De St. Joseph. Ann. Sc. nat., 7^e sér., t. i, p. 226.
 1908. „ *macrophthalmus*, Elwes. Journ. M. B. A., vol. viii, p. 201.
 1914. „ *macrophthalma*, Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 41.
 1915. „ „ Allen. Journ. M. B. A., n.s., vol. x, p. 604.
 1921. „ *macrophthalmus*, McIntosh. Ann. Nat. Hist., ser. 9, vol. viii, p. 307.

Habitat.—Dredged in various parts of Plymouth Sound (Allen); between tide-marks, Torquay (Elwes); Clew Bay (Southern).

Abroad it occurs in the Adriatic (Marenzeller); shores of France, common at Dinard (De St. Joseph); Madeira (Langerhans), where it occurs amongst algæ between tide-marks.

The *head* (Plate CXXXV, fig. 15) is distinguished by the large size of the eyes, which cover a considerable portion of the surface, and there are occasionally a few additional specks. The length of the body varies from 8—20 mm. The violet or reddish proboscis

is barrel-shaped, and has forty-four rows of violet points. The colour is light orange, and the tips of the tentacles are orange. The anterior and posterior bristles are figured in Plate CXXXV, fig. 15*a* and 15*b*.

De St. Joseph met with an example of 20 mm. in length in which the sexual elements covered the dorsal vessel and fell into the coelom; and another of seventy-two segments in which the head of a female bud with four eyes appeared at the fourteenth segment, yet it had no ova, no swimming-bristles, and no modification of the intestine. A third example, a nurse-stock of thirteen segments, had a female stolon of fifty-eight segments with the head well developed, the body filled with eggs from the third segment to within twenty of the tail. Its swimming-bristles were developing. From the fourteenth segment of other examples a male bud depended, with or without natatory bristles and altered or unaltered intestine, according to the development of the spermatozoa. In the sexual buds there were many red points on the ventral surface, and the segmental organs were developing. The French author is inclined to think with Langerhans that the *A. macrophthalmus* and *A. luxurians* of Marenzeller refer to the same form.

Southern also considers *A. luxurians*, Marenzeller, synonymous with this species, the only difference being that *A. luxurians* has small reddish-brown eyes, whereas in this the eyes are large and red.

AUTOLYTUS BRACHYCEPHALUS, *Marenzeller*, 1874. Plate CXXXV, fig. 16—head and anterior region.

Specific Characters.—Head with four large eyes, and occasionally additional specks, like Marenzeller's examples; palpi fused dorsally. Tentacular cirri and cirri of second segment longer than the following; conspicuous epaulettes behind head. Pharynx with thirty marginal papillæ, and the organ is reddish-violet. Body bluish-red, forty to sixty segments. Double row of pigment-grains on dorsal surface of each segment, long bar in front, shorter behind. Alternation in length of dorsal cirri. Two anal cirri. In the Irish examples there were thirty denticulations to proboscis—four much larger than rest—six smaller occurring between the larger.

Habitat.—Blacksod and Clew Bays, dredged (Southern). Abroad, Adriatic (Marenzeller), Madeira (Langerhans).

SYNONYMS.

- | | | | |
|-------|---------------------------------|--------------|---|
| 1874. | <i>Proceræa brachycephala</i> , | Marenzeller. | Sitzb. K. Akad. Wiss. Wien, p. 460, Taf. vi, fig. 2, and
Taf. vii, fig. 2. |
| 1879. | „ | „ | Langerhans. Zeitschr. f. wiss. Zool., Bd. xxxii, p. 580, Taf. xxxi,
fig. 12. |
| 1914. | <i>Autolytus</i> | „ | Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 41, pl. v, fig. 10. |
| 1921. | „ | „ | McIntosh. Ann. Nat. Hist., ser. 9, vol. viii, p. 308. |

The form appears to be typical in structure, the head and anterior region being represented in Plate CXXXV, fig. 16.

AUTOLYTUS PUNCTATUS, *De St. Joseph*, 1886. Plate CXXXV, fig. 17—head and anterior region.

Specific Characters.—Head of moderate size, with the anterior eyes large, the lenses projecting in front, the posterior pair smaller, with the lenses projecting backward. The median tentacle long, and so with the dorsal cirri of the first setigerous segment. Body in general larger than in *A. Ehbiensis*, colourless, except a faint tinge of orange at the extremities of the head and the first three segments. Each segment, except the buccal, bears a double transverse row of small greyish glands. The feet are typical. Proboscis short and straight, furnished with twelve obtuse denticulations anteriorly, alternating with another twelve pointed processes longer than those of *A. Ehbiensis*. Reproduces by stolons.

SYNONYMS.

1886. *Autolytus punctatus*, De St. Joseph. Ann. Sc. nat., 7^e sér., t. i, p. 233, pl. xi, figs. 108—109.
 1893. „ „ Malaquin. Syllidiens, p. 80.
 1914. „ „ Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 42.
 1915. „ „ Allen. Journ. M. B. A., n.s., vol. x, p. 605.
 1921. „ „ McIntosh. Ann. Nat. Hist., ser. 9, vol. viii, p. 308.

Habitat.—Blacksod Bay in Laminarian roots (Southern), Queen's Ground, and on the Eddystone trawling grounds, Plymouth (Allen).

Elsewhere it has been found at Dinard, France (De St. Joseph): Boulogne (Malaquin).

De St. Joseph mentions that it reproduces by a single stolon or by a chain of stolons. He observed both male and female buds. Allen procured specimens at Plymouth with stolons from May to June. The head and anterior region are represented in Plate CXXXV, fig. 17.

AUTOLYTUS EDWARDSI, *De St. Joseph*, 1886. Plate CXXXV, fig. 18—head and anterior region.

Specific Characters.—Head rounded, with four eyes behind the tentacles, which are slender. Body about 14 mm. long anteriorly, with a longitudinal streak of orange on each side of the dorsum in the nurse-stock. The dorsal cirrus of the second segment long, that of the third much shorter, whilst those which follow are nearly equal. The appendages of the head and the first three segments have their tips coloured orange. The proboscis has twenty-four small denticulations, and the reddish proventriculus is elongate and occupies segments 7—9. Bristles typical; that with an awl-shaped tip appears in the twenty-third segment. Reproduction by stolons, which have a pale-orange colour.

SYNONYMS.

1886. *Autolytus Edwardsi*, De St. Joseph. Ann. Sc. nat., 7^e sér., t. i, p. 235, pl. xi, fig. 110.
 1893. „ „ Malaquin. Syllidiens, p. 80, pl. viii, etc.
 1914. „ „ Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 43.
 1915. „ „ Allen. Journ. M. B. A., x, p. 605.
 1921. „ „ McIntosh. Ann. Nat. Hist., ser. 9, vol. viii, p. 308.

Habitat.—Blacksod and Clew Bays, Ballynakill Harbour (Southern). Common in dredgings from Duke Rock and the rocky ground south of the Breakwater, Plymouth. It also occurs in tubes attached to the fronds and roots of *Laminaria* in the same region (Allen).

Distribution.—De St. Joseph found it amongst the roots of *Laminaria*, and dredged amongst *Sertularia operculata*.

The body of this species has a longitudinal streak of orange on each side of the dorsum in the nurse-stock, and the appendages of the head (Plate CXXXV, fig. 18) have, with the first three segments, orange tips.

De St. Joseph observes that he occasionally met with an *Autolytus* which he could not distinguish from this species except by the absence of the two reddish-orange bands on the anterior segments. It also bore stolons, and he considered it a variety of this species.

Allen found the breeding season from March to June at Plymouth.

AUTOLYTUS LUGENS, *De St. Joseph*, 1886. Plate CXXXVII, fig. 6—head and anterior region.

Specific Characters.—Head comparatively small, surmounted by the massive median tentacle. Four eyes in the usual position. The lateral tentacles are small in comparison. Body typical, but small. The proboscis has only six denticulations, but is large, with a single volution. Proventriculus has twenty-six to thirty rows of grey points, and occupies segments 8—11. Reproduction by stolons.

SYNONYMS.

1886. *Autolytus lugens*, De St. Joseph. Ann. Sc. nat., 7^e sér., t. i, p. 234, pl. xii, fig. 116.
 1915. „ „ Allen. Journ. M. B. A., N.S., vol. x, p. 606.
 1921. „ „ McIntosh. Ann. Nat. Hist., ser. 9, vol. viii, p. 309.

Habitat.—Several examples were dredged on Queen's Ground and Millbay Pit, Plymouth (Allen).

It was discovered at Dinard by De St. Joseph.

The small head (Plate CXXXVII, fig. 6) is surmounted by a massive median tentacle. De St. Joseph met with specimens having male buds. Allen, again, observed stolons at Plymouth early in January and February, and a well developed one in July.

This is one of the Syllids which requires re-investigation, especially in connection with known forms.

Genus PROCERASTEIA, *Langerhans*, 1880.

Proboscis formed of a single cylinder, longer than in *P. nematodes*, Langerhans. Trepan armed with twenty to twenty-two teeth. Forty to forty-two segments before the period of reproduction, fifty-four to fifty-six on the appearance of the head of the stolon. Dorsal cirri developed only on the first setigerous segment. Feet with compound bristles—(1) with tips short, (2) with tip winged, and (3) simple bifid bristles in a group. Reproduction by stolons, with largely developed cirri. Colour uniform brown. Lives in the interior of Tunicates and in sponges, with Hydroids and Bryozoa.

PROCERASTEIA HALLEZIANA, *Malaquin*. Plate CXXXV, fig. 3—head and anterior region ; fig. 3a—bristles.

Specific Characters.—Proboscis forming a cylinder, longer than in *P. nematodes*, Langerhans. Trepan (proboscis) armed with twenty to twenty-two teeth. Segments forty to forty-two previous to reproduction, fifty-four to fifty-six immediately before the appearance of the head of the stolon. Coloration uniform light brown. Bristles are compound, terminal process short or awl-shaped, or simple bifid with terminal thickenings. Reproducing by stolons with long cirri. Lives in interior of tests of Tunicates (*Ciona*) amongst Hydroids and Polyzoa.

SYNONYMS.

1893. *Procerasteia Halleziana*, Malaquin. Rech. Syllid., p. 81, pl. xi, figs. 1—14, and pl. viii, fig. 26.
 1911. " " Potts. Ergebnisse u. Fortschritt. Zool., p. 30, text-fig. 10.
 1915. " " Allen. Journ. M. B. A., n.s., vol. x, p. 606.
 1921. " " McIntosh. Ann. Nat. Hist., ser. 9, vol. viii, p. 309.

Six specimens were procured amidst Ascidians from a raft moored in Cawsand Bay, Plymouth, in September (Allen).

The head and anterior region are shown in Plate CXXXV, fig. 3, and the tips of the bristles in fig. 3a, after Malaquin, no example having been available.

A brief, but excellent, summary of the stolonization of this form is given by Mr. F. Potts,¹ along with other types of reproduction in the Syllids. In *Procerasteia Halleziana*, as shown by Malaquin, the twelve to sixteen new segments are intercalated in the middle of the stock, and not at the posterior end as usual in the Syllids. Thus there may be in front twenty to twenty-two original segments, fourteen to sixteen of recent formation, and then eighteen to twenty or more of the original stock, the middle showing the more advanced development of the foot. The head of the stolon is formed on the fourteenth segment. The parts soon assume the condition of the adult.

Dr. Allen² observes (1921) that *Procerasteia Halleziana* was found at Plymouth living in membranous tubes on the stems of the hydroid *Syncoryne*. It was observed to feed by piercing the body-wall of the hydranths with its extruded pharynx and pumping out the contents of the gastral cavity of the hydroid. The proventriculus of the worm functions as a quick-acting pump, making from 150 to 200 pulsations a minute.

Sexual reproduction in *Procerasteia* is quite similar to that in *Autolytus*, each individual forming a single large stolon (with stolon-head on segment 14), which is set free as a male *Polybostrichus* or a female *Sacconereis*, before a second stolon is produced.

In addition to sexual reproduction, *Procerasteia* was found to be undergoing rapid multiplication by a process of asexual reproduction, consisting of fragmentation, followed by the regeneration of anterior and posterior ends.

Fragmentation can be induced by artificial means, and takes place in a definite way. The head and first seven setigerous segments form the first piece. This is followed by three

¹ 'Spengel's Ergebnisse und Fortschritte Zoologie,' Bd. iii, p. 30.

² 'Philos. Trans.,' ser. B, vol. ccxi, p. 131.

sections, of two segments each; these by three sections, of three segments each; and then by four or five sections, of four segments each. Behind these, sections of three segments reappear and are continued to the pygidium.

Experiments showed that the rate of regeneration of the different sections varied according to the region of the body from which they came, being most rapid in those from the middle region.

Regeneration of anterior segments appears to continue, until the original segments come to occupy exactly the same position in the regenerated worm as they had occupied in the parent, and then stops. Posterior regeneration was more active when the original segments came from the anterior end of the parent worm. The posterior portion of a female stolon regenerated a complete *souche* of thirteen segments, and had commenced to regenerate a stolon-head when it was found (Allen).

In connection with the Syllids, the recent interesting remarks of MM. Caullery and Mesnil¹ on viviparity and parthenogenesis may be mentioned. They found a form, *Ehlersia nepiotoca*,² n.s., amongst Lithothamnion at La Hague, with young at different stages of development to the number of a dozen in the coelom, and without traces of any male, or of hermaphroditism. They are inclined to suppose that in certain forms of these and other Syllids a life-cycle occurs, in which, after normal reproduction, parthenogenesis takes place, as in Aphides and *Cecidomya*, in some generations.

Pierantoni³ has also extended the list of species of *Pionosyllis* bearing ova or larvæ. His *P. gestans* has a series of fourteen to fifteen well-developed larvæ along the ventral surface; *P. elegans* bears eleven or twelve laterally; *P. papillosa* carries a large ovum on each side for twenty-one segments, whilst *P. minuta* has fewer ovigerous segments. The dull purplish ova of *Sphærosyllis hystrix*, again, are borne below the dorsal cirri.

A considerable number of Syllids (over a dozen) have been added to the British Fauna lately, and more will probably yet be found by a further minute search of shore and sea.

FAMILY NEREIDÆ.

Genus LEPTONEREIS, Kinberg, *char. emend.*

Proboscis with only soft papillæ; dorsal and ventral divisions of the foot distinctly divided. In the male heteronereid the body is divided into three regions, the middle only being modified for swimming, the posterior region having peculiar fused bristles.⁴

LEPTONEREIS GLAUCA, Claparède, 1870. Plate CXVI, fig. 9—head and anterior region.

Specific Characters.—Head short, about the depth of the buccal segment, posterior border entire; anterior eyes large, elliptical; posterior smaller, rounded; tentacles and

¹ 'Compt. rend.,' t. clxiii, p. 576, 1916.

² νεπίος, young, τέχος, viviparous.

³ 'Arch. Zool. Napoli,' vol. i, pp. 231—252, taf. x and xi, 1911.

⁴ Ramsay, 'Journ. M. B. A.,' 1914. *Vide* vol. ii, part ii, p. 263, for further information.

tentacular cirri comparatively short, the longest being the dorsal of the posterior tentacular cirri. Palpi "stout and squat." Body small, 25 mm. in length, segments fifty-five, of a light green colour anteriorly, tending to bluish, occasionally with a bronzed lustre; posteriorly yellowish-orange, due to the intestine, and in the females to the orange ova. Feet characterised by the distinct separation of the dorsal and ventral divisions, the tip of each having two triangular lobes; the dorsal cirrus is long, and the ventral short. Dorsal bristles with elongated tips and homogomph, ventral superiorly homogomph and heterogomph, inferiorly heterogomph and falciform heterogomph.

SYNONYMS.

1870. *Leptonereis glauca*, Claparède. Annél. Nap., Suppl., p. 90, pl. vii, fig. 3.
 1909. „ *vaillanti*, Elwes. Journ. M. B. A., vol. viii, p. 351.
 1910. „ „ McIntosh. Monogr. Brit. Marine Annelids, Ray Soc., vol. ii, pt. ii, p. 264, text-fig. 64.
 1913. „ *glauca*, Fauvel. Bull. Inst. Oceanogr., No. 270, p. 59.
 1914. „ „ Ramsay. Journ. M. B. A., vol. x, p. 244.
 „ „ „ Fauvel. Camp. Sc. Monaco, Fasc. xlvi, p. 163, pl. xii, figs. 5—23.
 1915. „ *vaillanti*, Allen. Journ. M. B. A., vol. x, p. 618.

Habitat.—A male heteronereid at Oddicombe in February (Elwes); piles of the wharf at Milbay Docks, Plymouth, fairly numerous (Ramsay).

Abroad it was found originally at Naples by Claparède.

The description of this species has already been given under *Leptonereis vaillanti* in the volume published in 1910, p. 264, with a figure, and a coloured figure is now added (Plate CXVI, fig. 9).

NEREIS ZONATA, *Malmgren*, 1867. Text-fig. 172.

Specific Characters.—Head resembling that of *Nereis pelagica*, but the eyes somewhat larger, and the tentacles and tentacular cirri longer and more slender. A band of dark pigment runs in the line of the eyes, and another of white passes forward between them. Maxillæ with six to seven teeth; paragnathi generally finer than in *N. pelagica*; groups VII and VIII differ, the former presenting the two largest in the series, and the larger distal denticles are more isolated, whilst the proximal are more minute. Body typical. The lobes of the feet are more acute than in *N. pelagica*, and the coloration is distinctive, viz., dorsally banded with reddish brown.

SYNONYMS.

1867. *Nereis zonata*, Malmgren. Annul. Polych., p. 46, Tab. v, fig. 34.
 1868. „ „ Ehlers. Borstenwürmer, ii, p. 510.
 „ „ *procera*, idem. Ibid., ii, p. 557, pl. xxiii, fig. 2.
 „ „ *cylindrata*, idem. Ibid., ii, p. 506, pl. xxi, figs. 37—40.
 1870. „ *zonata*, Grube. Arch. f. Naturges., p. 310.
 1873. „ „ idem. Jahresb. Schles. Gesell., 1873, p. 15.
 „ „ „ Kupffer. Jahresbericht Comm. deut., 1 Jahrg., p. 150.
 1874. „ „ Malm. Annul. Göteborg. Kgl. Vet. Vitt. Handl., Heft xiv, p. 83.
 1877. „ „ Marenzeller. Nordpol. Exped., p. 40.
 1878. „ „ McIntosh. Trans. Linn. Soc., Zool., ser. 2, vol. i, p. 503.

1879. *Nereis zonata*, Théel. Polych. Nouv.-Zemb., p. 42.
 " " " Tauber. Annulat. Danic., p. 96.
 " " " Verrill. Check-list Annel. Atlantic Coast, p. 8.
 1880. *Lycoris procera*, Langerhans. Zeitschr. f. wiss. Zool., Bd. xxxiii, p. 285, pl. xv, fig. 11.
 1881. *Nereis zonata*, Horst. Polych. Barents Exped., p. 11.
 1883. " " Levinsen. Vid. Meddel. nat. Forh. Copenhagen, p. 234.
 1885. " " Wirén. Chætop. "Vega" Exped., p. 402.
 1888. " *procera*, De St. Joseph. Ann. Sc. nat., 7^e sér., p. 266, pl. xi, fig. 132.
 1890. " *zonata*, Malaquin. Annel. Boulon, p. 29.
 1892. " " Marenzeller. Polych. Bremer Exped., p. 401.
 1894. " " Bidentkap. Norg. Polych., p. 85.
 1897. " *arctica*, Michaelsen. Polych. Deutsch., pp. 18 and 102.
 1899. " *procera*, Allen. Journ. M. B. A., vol. v, p. 481.
 1901. " " Johnson. Polych. Puget Sound, Proc. Boston Nat. Hist. Soc., vol. xxix, p. 400,
 pl. iv, fig. 47, pl. v, figs. 53—59.
 1908. " *zonata and cylindrata*, Ehlers. Deutsch. Tiefsee Exped., pp. 68 and 71.
 1910. " " Southern. Proc. Roy. Irish Acad., vol. xxviii, p. 232.
 " " " Snellen et Ekama. Exped. Neerland. Kara, p. 123 (Utrecht).
 " " " Ditlevsen. Danmark Exped. Grönland, Bd. v, No. 9, p. 419.
 " " " Fauvel. Polych. Camp. Arct., p. 23, pl. i, figs. 1—5.
 1912. " " McIntosh. Ann. Nat. Hist., ser. 8, vol. x, p. 122.
 1915. " " Allen. Journ. M. B. A., n.s., vol. x, p. 619.
 1916. " " Fauvel. Annel. Pelag. Camp. Sc. Monaco, p. 78, pl. vii, figs. 11—14.

Epitokous Form.

1865. *Heteronereis grandifolia*, Malmgren (*partim*). Nord. Annel., p. 108, pl. xi, fig. 16.
 " " *glaucopis*, idem. Ibid., p. 181.
 1911. *Nereis procera*, Moore. Proc. Acad. Nat. Sc. Philad., vol. lxiii, p. 245, pl. xv, fig. 18.

Fauvel (1916) has done good service in showing that *Nereis procera* of Ehlers is only a variety of *N. zonata*. He has also given a careful description of the epitokous forms.

Habitat.—Lambay Deep, Irish Sea (Southern), Plymouth (Allen).

It occurs frequently at Spitzbergen and Greenland (Malmgren, McIntosh), and has a wide distribution in northern waters, and at considerable depths. It also extends to the Persian Gulf (Fauvel).

The *head* (Fig. 172) resembles that of *Nereis pelagica* in general shape, but the eyes are somewhat larger and the tentacles and tentacular cirri are longer and more slender. A band of dark pigment runs in the line of the eyes, and a stripe of white passes forward between them.

The *body* has a distinctive coloration, viz., a pale reddish-brown hue in spirit, though Malmgren adds—yellowish or bluish to reddish brown. The examples from the "Valorous" Expedition to the Arctic seas were distinctly banded with brown—a feature very evident in young specimens. The anal cirri are slightly longer than in *N. pelagica*, though weight need not be put on this. The maxillæ of the proboscis have the same number of teeth, those of *N. pelagica*, perhaps, being usually more distinct, and the tip, if anything, is more slender (Fig. 172). The paragnathi generally are finer than in *N. pelagica*, and I. is absent in the present examples as well as in those procured by the "Valorous" in Greenland, and at

most is represented by a single horny point, as in Marenzeller's specimens. The groups in II. are somewhat smaller individually, and apparently less numerous than in *N. pelagica*. III. forms a longer transverse band of more minute denticles, and group IV. is composed of more acute paragnathi in a double curve, the inner formed of smaller denticles. V. is absent, as in *N. pelagica*, and VI. forms a group of smaller denticles than in *N. pelagica* on the elevations at each side. This group is very variable in *N. pelagica*, occasionally only a single large denticle being present on each side, and in all cases the paragnathi are larger. VII. and VIII. form the basal row in extrusion, and no groups differ from the homologous parts in *N. pelagica* more than these. VII. shows the two largest paragnathi in the series constituting a basal band in extrusion, and which (band) differs from that of *N. pelagica* in the isolation of the larger distal and the minuteness of the proximal denticles. In *N. pelagica* the large distal paragnathi are much more numerous and less regularly arranged, and the proximal smaller denticles are likewise in greater numbers. Side by side the contrast between the two is noteworthy.

In glancing along the feet of the two forms the rounded and blunt condition of the tips of the processes in *N. pelagica* distinguish it, for in *N. zonata* the lobes are much more acute, and Malmgren's figures originally indicated this clearly.



FIG. 172.—Proboscis of *Nereis zonata*. After Malmgren.

Nereis zonata, Malmgren, var. *persica*, Fauvel, occurs in the Persian Gulf, and has lately been carefully described by Prof. Fauvel¹ both in the ordinary and epitokous conditions. The author also states that he considers *Nereis procera* of Ehlers to be the same species, and so with *Nereis pulsatoria* of Grube. He concludes that *Heteronereis grandifolia* ♀, Malmgren (*Heteronereis assimilis*, Rathke), is the epitokous condition of *Nereis zonata*. *N. zonata* appears to have a very wide distribution both off the Atlantic and Pacific shores.

The epitokous forms of *Nereis pelagica* are distinguished from those of *N. zonata* by the coloration, the latter having light transverse bands which are not present in the former, and the paragnathi of groups I. and VI. In *N. pelagica* the lobes of the feet are evenly rounded, whilst in *N. zonata* they are triangular and run out to a broad point. Ditlevsen, who has recently written on the subject, further notes that in *N. pelagica* the terminal processes of the bristles are shorter and more curved than in *N. zonata*. The author disagrees with Michaelsen's view that *Heteronereis arctica* of Ørsted is the female epitokous form of *N. zonata*, and therefore thinks that the title *N. zonata* should stand. Moreover, whilst *N. pelagica* is generally a littoral species, *N. zonata* is procured by the dredge.²

¹ 'Arch. Zool. Expér.,' vol. xlvi, p. 382, pls. xix and xx (April, 1911).

² Herpin has studied the lymphocytes in the perivisceral chamber of Nereids, and considers that they nourish the slowly-developing eggs. Moreover, he thinks that the presence of ova in an annelid does not prove that the animal is adult ('Comp. Rend. Acad. Sc. Paris,' July 25th, 1921).

FAMILY EUNICIDÆ.

MARPHYSA FALLAX, *Marion & Bobretzky*, 1875. Plate CXXXV, fig. 24—head and anterior region, fig. 24a—foot.

Specific Characters.—The cephalic lobe presents a median bay so as to make it somewhat bilobed, and it carries five tentacles, the two outer being a little shorter than the three central. Body of 31 mm. or more in length, with 100 or more segments, and has the general aspect and colour of *Lysidice ninetta*, the dorsum being bright red, with small points of white. The first segment is of a reddish violet—a tint rendered the more conspicuous by the pallor of the second segment. The branchiæ commence on the fourth or fifth setigerous segment (fourteenth segment, Southern), the first three or four consisting of a simple filament a little longer than the dorsal cirrus. The following nineteen have two filaments longer than the dorsal cirrus; then follow ten with a single filament. The posterior region is bare. The typical foot bears dorsally the branchiæ on the dorsal cirrus with its spine, the inferior division has a spine emerging at the terminal papilla of the setigerous process, and it separates the ventral bristles into two groups, an upper series of winged bristles curved and tapered distally with others brush-shaped, and a lower series of compound bristles, one or two having beneath them hooks with long shafts. Both kinds of bristles are bifid at the tip and furnished with wings. A third kind of bristle, fewer in number, has a long tapering terminal process articulated to the end of the shaft. The ventral cirrus is pinniform. The funnel-shaped anal segment has a crenate border, and bears four cirri of different lengths ventrally on each side, the longest being median and the shortest internal—in the Irish specimen.

It is possible this may be a young form, and that its relationship with known species may yet be discovered. De St. Joseph thinks it approaches *M. sanguinea* in the position of the branchiæ, which are simple.

SYNONYMS.

1875. *Marphysa fallax*, Marion and Bobretzky. Ann. Sc. nat., 6^e sér., t. ii, p. 12, pl. i, fig. 1 A—I.
 1888. „ „ De St. Joseph. Ibid., 7^e sér., t. v, p. 205.
 1914. „ „ Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 87, pl. viii, fig. 20.
 1922. „ „ McIntosh. Ann. Nat. Hist., ser. 9, vol. ix, p. 13.

Habitat.—Under a stone at Bananagh, Blacksod Bay (Southern). Elsewhere it occurs at Marseilles (Marion and Bobretzky); Dinard, France (De St. Joseph).

Marion and Bobretzky observe that the compound bristles with the bifid tips differ from those of *M. sanguinea*, and that the dental apparatus also diverges from that of the latter species in so far as six denticulations occur on the maxillæ. Southern notes four ventral cirri on the anal segment and three spines in the ventral division of the foot. De St. Joseph found his examples in the dredge, and with a coloration approaching that of *Lysidice ninetta*. They were small, viz., 15 mm. in length. The bristles (Plate CXXXV, fig. 24a) resemble those of *Marphysa Belli*, but the species differs in regard to the branchiæ and in the form of the head (Plate CXXXV, fig. 24).

FAMILY OPHELIIDÆ.

ARMANDIA FLAGELLIFERA, *Southern*, 1914. Plate CXXXVII, figs. 8—8*b*—anterior and posterior ends.

Specific Characters.—The cephalic region tapers to a slender, pointed tip, but is not clavate. Nuchal organ a rounded pit on each side. Proboscis with thirteen slender papillæ. Body typical, about 12 mm. long, rounded dorsally, grooved ventrally, and tapered at each end. Setigerous segments thirty-three. Lateral eyes sixteen, from the fourth to the nineteenth. Anal funnel a flattened tube, ringed externally and opening dorsally, the aperture being four-lobed, each lobe with a fusiform papilla. A slender cirrus springs ventrally from the base in front of the anal funnel.

SYNONYMS.

1914. *Armandia flagellifera*, Southern. Proc. Roy. Irish. Acad., vol. xxxi, No. 47, p. 132, pl. xiv, figs. 31 A—D.
 1922. „ „ McIntosh. Ann. Nat. Hist., ser. 9, vol. ix, p. 13.

Habitat.—Captured in a tow-net at night near the entrance to Ballynakill Harbour, and dredged in 11 fathoms in mud, Galway Bay (Southern). The *cephalic* region (Plate CXXXVII, figs. 8 and 8*a*) tapers to a slender point, which does not show a clavate tip. The extruded proboscis is furnished with thirteen slender papillæ (Southern). Nuchal organ conspicuous on each side in front of the first bristle-bundle. The *body* is fully 12 mm. long, tapered at both ends, but nearly of uniform diameter throughout the rest of its extent. It is rounded dorsally, deeply grooved ventrally from the snout to the anal funnel. Setigerous segments thirty-three, each with three rings, and each ring biannulate (Southern). The dorsal cirri are filiform and fairly long. An eye-speck is situated behind each foot from the fourth to the nineteenth, and each consists of small spheres of pigment or a single mass (Southern). In lateral view the body abruptly narrows to the anal funnel, which is a flattened tube with a dorsal opening posteriorly. The margin of the funnel is papillose posteriorly, Southern describing the opening as projecting in four lobes, each bearing a fusiform papilla. A long slender cirrus, nearly twice as long as the anal funnel, arises from the ventral base in front of the funnel.

The feet occupy the upper and outer border of the ridges made by the ventral longitudinal muscles. The setigerous lobe is rounded, and bears superiorly the long, subulate cirrus, in which at least one blood-vessel is present, then a tuft of simple capillary bristles; ventrally a similar tuft of bristles and a small, somewhat clavate ventral cirrus (Southern).

FAMILY SCALIBREGMIDÆ.

Genus ASCLEROCHEILUS, *Ashworth*, 1901.

Pigment-masses on the head absent. Curved acicular bristles finer than those of *Sclerocheilus* occur on the first three bristled segments. No ventral cirri.

ASCLEROCHEILUS INTERMEDIUS, *De St. Joseph*, 1894. Plate CXXXVIII, figs. 8 and 8a—bristles.

Specific Characters.—Head devoid of pigment-specks, but similar to that of *Sclerocheilus*. Body similar in outline to that of *Sclerocheilus*, but the feet bear no cirri. The bristles of the first three segments are finer, and of a different form from those of *Sclerocheilus*.¹ The segmental organs, again, correspond in structure. The ova are greyish.

SYNONYMS.

1894. *Lipobranchus intermedius*, De St. Joseph. Ann. Sc. nat., 7^e sér., t. xvii, p. 113, pl. v, figs. 146—147.
 1901. *Asclerocheilus* „ Ashworth. Quart. Journ. Micr. Sci., pp. 294, 297.
 1914. „ „ Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 137.
 „ „ „ Fauvel. Annél. Polych. Monaco, p. 238, pl. xxi, figs. 13—18.
 1922. „ „ McIntosh. Ann. Nat. Hist., ser. 9, vol. ix, p. 14.

Habitat.—Between tide-marks and dredged in 1 fathom, Blacksod Bay, in the roots of tangles; Ballynakill Harbour, 1—3 fathoms, also in roots of tangles, and between tide-marks, Malahide, and other places on the west coast of Ireland (Southern).

Distribution.—Dinard, France (De St. Joseph); Azores, 760 fathoms.

It is a small species, measuring about 2 or 3 mm., the anterior end being distinguished by two rounded processes with a depression between. The body is somewhat fusiform in outline, slightly tapered anteriorly, and abruptly so posteriorly, with about twenty segments. So far as seen, no ventral cirrus is present, and no eyes. The ventral hooks of the second segment (Plate CXXXVIII, fig. 8) have a marked curve backward (sickle-like) at the tip, and terminate in sharp, not attenuate, points. The upper bristles (Plate CXXXVIII, fig. 8a) of the second segment are capillary, with finely tapered, long points. The posterior bristles are more elongate. Apparently transverse rows of opaque glands occur posteriorly in each segment.

FAMILY SPHÆRODORIDÆ.

SPHÆRODORUM CLAPARÈDII, *Greef*, 1866. Plate CXXXVI, fig. 4—bristle.

Specific Characters.—Two reddish-brown eye-specks on the buccal segment, and when the “stomach” is everted these are carried with it. Body with six rows of papillæ on the dorsum. Mature in April and September.

SYNONYMS.

1866. *Sphærodorum Claparèdii*, Greef. Arch. f. Naturges., Bd. xxxii, p. 338, Taf. vi.
 1914. „ „ Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 89.
 „ „ „ Fauvel. Annél. Polych. Monaco, p. 97.
 1922. „ „ McIntosh. Ann. Nat. Hist., ser. 9, vol. ix, p. 15.

¹ An important memoir by A. and L. Dehorne on *Sclerocheilus minutus* goes fully into the structure and relationships of this species, the nervous system, alimentary canal, and the nephridia being specially treated—chiefly from sections (Arch. Zool. Expér., t. liii, p. 61, Pls. 4—7 and text-figs., 1913).

Habitat.—Blacksod Bay, amongst sea-weeds on shore, and Ballynakill Harbour, in the surface tow-nets (Southern).

Distribution.—Dieppe.

This appears to be a form so closely allied to *S. minutum* that hesitation is felt in separating them. It may be a young form developing reproductive elements. The bristles of this and *S. minutum* differ very little, and the only other feature which was noticed was the somewhat more regular arrangement and size of the papillæ in *S. minutum*.

SPHÆRODORUM MINUTUM, *Webster & Benedict*. Plate CXXXVI, figs. 5 and 5a—bristles.

Specific Characters.—Head narrow anteriorly, covered with papillæ; two dorsal and two ventral tentacles in front, their basal portions papillose, whilst behind them is a short, thick median tentacle. Buccal segment has a pair of cylindrical tentacular cirri—either with or without papillæ, and dorsal to them a pair of dark reddish-brown eyes with lenses. Body 2—3 mm. long, and of seventeen to twenty-two setigerous segments, rounded dorsally and flattened ventrally. Each segment has a row of ten to twelve large globular papillæ dorsally in a line with the feet, and smaller papillæ are scattered over the body, but no large papillæ occur on the ventral surface. Anal segment with two large globular papillæ laterally, and a long, cylindrical median one. The barrel-shaped stomach occupies two and a half to three segments, is dark in colour and furrowed along one side, as well as transversely striated; anterior margin smooth, with a thickened rim. Foot consists of a rounded setigerous process with a pointed spine, a large cylindrical ventral cirrus, and a smaller but similar papilla on the anterior face of the setigerous lobe. Bristles slightly curved, the end of the shaft enlarged and serrated on one edge, terminal piece curved at the tip. Mature specimens occurred from June to August, and usually were captured in the surface tow-net at night. The eggs are reddish purple (Southern).

SYNONYMS.

1887. *Ephesia minuta*, Webster and Benedict. U.S. Com. F. and F., vol. xiii, p. 728.
 1913. *Sphærodorum minutum*, Fauvel. Bull. Inst. Oceanogr., No. 270, p. 37.
 1914. " " Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 90, pl. ix, figs. 21 A—H.
 " " " Fauvel. Annél. Polych. Monaco, p. 96, pl. vii, figs. 19—21.
 1915. " " Allen. Journ. M. B. A., vol. x, p. 626.
 1922. " " McIntosh. Ann. Nat. Hist., ser. 9, vol. ix, p. 15.

Habitat.—Blacksod Bay, in Laminarian roots; Clew Bay, in 24 fathoms, on sand and shells; dredged in Ballinakill Harbour in 2—8 fathoms, and taken in tow-net at night (Southern). Trawled in the Cattewater and found amongst Laminarian roots in Rum Bay, Plymouth (Allen).

North Atlantic, Eastport, Maine (Webster and Benedict); Spitzbergen (Fauvel).

The description of this form is after Southern, since the material at hand did not suffice to afford a satisfactory conclusion.

EUMENIA HYSTRICIS, *McIntosh*, 1922.

SYNONYM.

1922. *Eumenia hystricis*, McIntosh. Ann. Nat. Hist., ser. 9, vol. ix, p. 3.

Dredged in the Channel slope at Station 8, "Porcupine" Expedition, 1870, at a depth of 257—690 fathoms, amidst a fauna chiefly northern.

A fragment devoid of the anterior region, resembling a curved larva of an insect, of a rounded form, and apparently thickest posteriorly, for it tapers anteriorly, where the segments are longer, and closely ringed throughout the rest of its extent. Each segment bears two short gills, thus differing from *Eumenia crassa* or *E. Jeffreysii*, and they are longest behind the middle and diminish in the caudal region. They spring apparently from the posterior edge of each segment-junction, and generally in the preparation present a somewhat club-shaped outline, with a firm cuticular investment having a finely granular hypoderm beneath. They are marked by transverse striæ, probably due to the circular fibres, whilst internally is a large blood-vessel, which may form a loop distally, though the state of the specimen rendered this uncertain. Some of the gills contained large granular cells, but the nature of these has not been ascertained.

The segments are simple—that is, without rings—each dorsally slightly overlapping the anterior edge of the succeeding segment, and from the curve of the body the dorsal antero-posterior diameter is wide, the ventral narrow. The posterior segments become increasingly narrow, and terminate in the anus, which has beneath it two papillæ. The dorsal surface of the body is convex; the ventral presents a slightly flattened surface, with a shallow groove posteriorly. The cuticle, moreover, by dipping in formed a series of reticulations, which here and there were arranged in long rows.

A remarkable feature was the apparent absence of bristles, no trace of which was observed until the fragments were put in xylol, when a vertical row of minute points—apparently the bases of bristles, though at first sight resembling minute uncini, was observed. The arrangement of the gills at once distinguishes this species from *Eumenia crassa*, Cerst., and *E. Jeffreysii*, McL.

FAMILY PARAONIDÆ, *Cerutti*, 1909.

Marine annelids with numerous segments, median sensory process anteriorly; median tentacle; two eyes; nuchal organs; metastomial region with bristles; branchiæ from the third to the sixth segment; modified (lyrate) bristles in the posterior dorsal tufts.

PARAONIS LYRA, *Southern*, 1914. Plate CXXXVI, fig. 3—bristle.

Specific Characters.—Head somewhat bluntly conical, with a low rounded papilla bearing stiff cilia on the tip, and having yellowish pigment. Nuchal organs brownish, large and conspicuous, sloping obliquely backward and inward from the mid-lateral region. Body widest in the middle, tapering toward each end, 20 mm. long, and with 95—105 segments. Three anterior segments have capillary bristles and small dorsal cirri, but the

latter gradually increase in size, and are long and slender in the posterior segments. Anal segment rounded, with three slender subulate cirri, two dorso-lateral and one median ventral; a pair of cirri fixed to the anterior border, which may represent the last pair of dorsal cirri. Anteriorly the dorsal and ventral bristles are almost equal in length, and continue so to the posterior end in the immature, but in the mature male the ventral increase in length about the fifteenth to the twentieth segment, whilst the dorsal become shorter. The bristles of the male are more prominent than in the female, exceeding the width of the body, especially posteriorly. The dorsal cirri are placed behind the fascicle of bristles. Capillary bristles slender, devoid of wings, and the longer ventral bristles in the male are striated longitudinally. On the lower side of the front row of the dorsal tuft are one to three short bristles with lyrate tips, one end being longer than the other and with a row of spines on its inner margin, this type commencing in the fourth segment and continuing to the tail. In the fourth foot the dorsal bristles are slightly longer than the ventral; in the fiftieth foot the ventral are thrice as long. In the male the upper ventral bristles are longer and thicker as well as longitudinally striated—a condition not present in the female. In the eightieth foot the differences between the dorsal and ventral bristles are less pronounced. Red ova appear in the female in the twentieth segment, usually four in each (Southern).

SYNONYMS.

1914. *Paraonis lyra*, Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 94.

1922. „ „ McIntosh. Ann. Nat. Hist., ser. 9, vol. ix, p. 14.

Habitat.—Mature male in surface tow-net at night, Galway and Dingle Bays (Southern). The genus has a wide distribution, from Sweden southward.

A typical bristle is shown in Plate CXXXVI, fig. 3.

Genus ARICIDEA, Webster, 1879.

Head with a sensory median process; two eyes; nuchal organs. Branchiæ only on the anterior segments. Feet biramous, dorsal cirri, ventral rami with cirri only on the anterior segments. Bristles simple, capillary; first segment with bristles; no tentacular cirri.

ARICIDEA JEFFREYSII, McIntosh, 1878.

Specific Characters.—Head bluntly pointed, and divided into three regions by two antero-posterior curved lines, which with the central region are marked with dark pigment posteriorly. In front of this is the somewhat short and clavate tentacle, which has a constricted base rising from an elevated portion of the snout. Body flattened from above downward and long. The first segment bears only the dorsal and ventral bristle-tufts; the second has, in addition, a dorsal cirrus, whilst the fourth has a branchial process. The branchiæ remain of considerable size (*i.e.*, nearly meet in the middle of the dorsum) for eight segments, then diminish to the fifteenth, in which they are very small. Bristles simple and striated with wings, and they increase in length to the end of the fragment.

SYNONYMS.

1878. *Scolicolepis* (?) *Jeffreysii*, McIntosh. Trans. Linn. Soc., ser. 2, vol. i, p. 506.
 1879. *Aricidea fragilis*, Webster. Trans. Albany Inst., vol. ix, p. 55, pl. ix, figs. 127—132.
 1909. „ *Jeffreysii*, Cerruti. Mitt. Zool. Stat. Neap., Bd. xix, p. 469, Tav. xviii and xix.
 1914. „ „ Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 93.
 1922. „ „ McIntosh. Ann. Nat. Hist., ser. 9, vol. ix, p. 15.

Habitat —Ballynakill Harbour, 2—4 fathoms, Clew Bay, 24 fathoms (Southern).

Distribution.—“Valorous” Exped. (McIntosh); Mediterranean (Cerruti); United States of America (Webster and Benedict, Treadwell).

In transverse section the body toward the anterior third presents an ovoid outline. The cuticle is well-marked, and the hypoderm thick, especially along the entire ventral surface. The dorsal longitudinal muscles are considerably less than the ventral, and a large gap occurs in the median raphe. The ventral longitudinal muscles are separated by a central interval, at the bottom of which the nerve-cords lie, the oblique muscles passing over their summit. The circular muscular coat is much developed, but the lateral vertical bands supplement it. The alimentary canal is rounded in section, has a thick circular muscular coat, and the glandular inner surface is richly ciliated.

It is probable that the *Aricidea quadrilobata*, the *A. nolani* of Webster and Benedict, and the *A. alata* of Treadwell belong to this species. The *Cirrophorus branchialis* of Ehlers is also an allied form.

FAMILY CHÆTOPTERIDÆ.

Genus SPIOCHÆTOPTERUS, Sars, 1856.

Cephalic lobe small, rounded, eyeless; peristomium forming a funnel-like process—in the middle of which is the mouth. Two long, grooved tentacular cirri resembling those of a *Spio*. Body slender, elongate, in three regions, anterior, middle and posterior, the first with nine bristled segments, the second of two long segments having only foliaceous lamellæ with included capillary bristles dorsally, and the third of numerous segments with conical feet. Posterior segments with very minute thin hooks. Tube hyaline, brittle and ringed, attached by one end, unbranched.

SPIOCHÆTOPTERUS TYPICUS, Sars, 1856. Plate CXXXVIII, fig. 14—hook.

Specific Characters.—Head small, rounded, devoid of eyes. Peristomium forming a funnel, with the mouth in the centre, and with a small process on each side of the head. Tentacular cirri long, slender, and grooved. Body having an anterior region of nine bristled segments, the fourth bearing in addition a large, tooth-like bristle with an oblique free surface. The middle region consists of only two elongated segments carrying foliaceous lamellæ, which dorsally enclose capillary bristles. The posterior division has 130—140 segments, which are longer in front, shorter posteriorly, each bearing sub-cylindrical feet with bulbous

tips, and spear-shaped bristles, the minute and diaphanous hooks having a rounded apex, and a thickened anterior margin (probably roughened) and a small main fang. Tube hyaline, horny and ringed, fixed by the posterior end.

SYNONYMS.

1856. *Spiochætopterus typicus*, Sars. Fauna Lit. Norveg., ii, p. 1, figs. 8—21.
 1865. „ *typus*, De Quatrefages. Annelés, ii, p. 217.
 1873. „ *typicus*, Sars. Bidrag. Christ. Fauna, p. 62.
 1883. „ „ Levinsen. Vid. Meddel. Nat. Forh. Copenhagen, p. 108.
 1908. „ „ McIntosh. Ann. Nat. Hist., ser. 8, vol. ii, p. 535.
 1914. „ „ Fauvel. Annél. Polych. Monaco, p. 266, pl. xxv, figs. 5—9.
 1915. „ „ McIntosh. Monogr. Brit. Mar. Annel., p. 132.
 1922. „ „ *typicus*, idem. Ann. Nat. Hist., ser. 9, vol. ix, p. 16.

Habitat.—Tubes occur in St. Andrews Bay (E. M.), Loch Linnhe, in 35—37 fathoms (J. G. J.).

Distribution.—Shores of Norway (Sars) ; Gulf of St. Lawrence, Canada (W. C. M.).

Each segment posteriorly in the sole imperfect example secured (Loch Linnhe) has dorsally a pair of setigerous processes bearing a group of about four bristles, with long shafts and flattened spear-like tips. Two flaps or lamellæ occur laterally below the foregoing and bear very transparent hooks (Plate CXXXVIII, fig. 14), the outline of which is somewhat triangular, with a rounded apex, a thickened anterior margin, which is probably minutely serrated, though in the preparations such was not seen, and ending inferiorly in a short main fang. The transparency of these organs renders it difficult to make out their outlines, and they escaped Sars.

Genus PHYLLOCHÆTOPTERUS, Grube, 1863.

Prostomium small, bearing eyes. Peristomium forms a well-developed funnel, and bears a pair of tentacles of variable length, and a pair of small, flat structures apparently homologous with these, and generally covering the eyes. Collar shallow and incomplete dorsally. Median and posterior regions present. Segments in the former with bilobed, foliaceous dorsal processes, each carrying several capillary bristles ; number of segments in the median region variable. Dorsal division of the foot forms a single conical lobe with bristles. Tooth-like bristle in the fourth segment. Hooks minute, translucent ; somewhat conical, with a long, curved, minutely serrated anterior margin ; posterior border concave ; base convex in front, concave posteriorly. More than one individual in the same system of tubes, which are reptant, often parallel, with occasionally short lateral connections.

PHYLLOCHÆTOPTERUS ANGLICUS, Potts, 1914. Plate CXXXVI, figs. 12 and 12a—large bristle and hook.

Specific Characters.—Head (prostomium) rather broad, though small, its borders with a line of dark pigment ; eyes on the extreme sides of the head, and are overlapped and hidden

by the small, slender, peristomial appendages. Peristomium forms a well-developed funnel. Body $2\frac{1}{2}$ to 6 inches in length; anterior region of twelve to sixteen segments (usually twelve), with a single tooth-like bristle in the fourth segment; median region has eleven to twenty-five segments. Tubes creeping, parallel, usually non-adherent, with short lateral connections; more than one example in the same system of tubes; small subsidiary apertures at the end of branchlets (Potts).

SYNONYMS.

1914. *Phyllochætopterus anglica*, Potts. Proc. Zool. Soc., p. 984, pl. vi, text-figs. 9, 10 and 12.
 1915. „ „ Allen. Journ. M. B. A., vol. x, p. 631.
 1922. „ „ McIntosh. Ann. Nat. Hist., ser. 9, vol. ix, p. 16.

Habitat.—Trawled to the south of the Eddystone, Plymouth (Potts).

This species was discovered by Mr. Potts at Plymouth in 1913, and though it presents

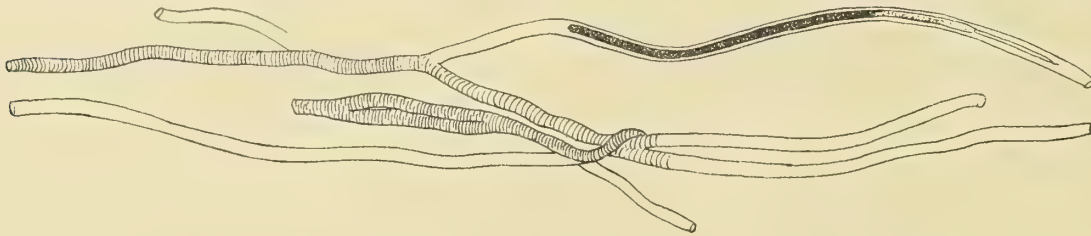


FIG. 173.—Tubes of *Phyllochætopterus anglicus*, about natural size. After Potts.

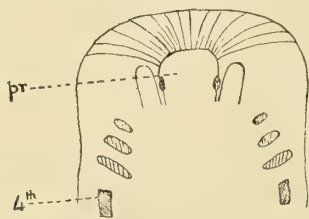


FIG. 174.—Diagrammatic dorsal view of the head and anterior segment of *Phyllochætopterus anglicus*, Potts, after Potts, showing the prostomium, *pr*., and the tooth-like bristle of the fourth segment.

close relationships with forms he had met with on the Pacific Coast of Canada, and appears to be intermediate between *P. prolifera* and *P. socialis*, Clap., yet he considers that it merits specific distinction, not only because the tubes (Fig. 173) run parallel, and are not, as a rule, adherent, though connected, but from the morphological characters of the animal. Further investigations, however, in view of the cosmopolitan distribution of many similar forms and the necessity of allowing a wide margin for variations, may tend to minimise the present differences shown in the careful and well-illustrated description of Potts.

The British species appears to live in water of some depth south of the Eddystone, and had been captured by trawlers.

In connection with the structure of the peristomial appendages, Potts considers that since the second pair contain, as Claparède pointed out in *P. socialis*, a few slender capillary bristles, they may represent the modified dorsal division of the foot of the segment.

While giving a full description of the bristles, one of the larger forms of which is figured in Plate CXXXVI, fig. 12, Mr. Potts does not give details of the minute hooks, which escaped

both Sars and Grube. They are very minute translucent structures (Plate CXXXVI, fig. 12*a*), somewhat conical in outline, with a long curved anterior margin most minutely serrated, the serrations readily escaping detection even under high powers. The posterior border is concave, and the base is convex in front, concave posteriorly (O. G. curve).

Potts considers that the conical peristomium is primitive, and that the formation of the peristomial funnel is a direct adaptation to microphagous habits. The prostomium is a definite structure, but varies in the several species, being better developed in some than in others. It is better developed in *P. anglicus* (Fig. 174) than in *P. elioti* from Zanzibar.

FAMILY SPIONIDÆ.

PYGOSPIO SETICORNIS, *Ærst*, 1843. Plate CXXVI, fig. 12—hook; Plate CXXXVI, figs. 10—10*b*—bristles.

Specific Characters.—Head with an elevated central ridge slightly bifid anteriorly, and bearing the four eyes. Peristomial areas lateral. Body typical, the branchiæ arising on the second setigerous segment, and distinct from the dorsal lamella (Cunningham and Ramage). Second, fourth and following segments devoid of branchiæ, which again appear at the twelfth and several following segments, disappearing toward the posterior extremity; eighth and following ventral divisions of the foot bearing only hooks. Tail with four lobate processes. Anterior bristles stouter and more boldly curved, with a scoop-shaped lamella in front of them; those at the tail are nearly straight. Hooks commence on the seventh bristled segment, and are typical, a single tooth occurring above the main fang and they have a hood. Tubes of tough, flexible secretion, coated with sand.

SYNONYMS.

- 1780.? *Nereis seticornis*, O. Fabr. Fauna Grœnl., p. 306.
 1843. *Spio seticornis*, *Ærst*. Grönl. Annul. Dorsib., p. 203.
 1844. „ „ idem. Arch. f. Nat., p. 106.
 1845. „ „ idem. Annul. Dan. Consp., p. 40, Tab. vii, fig. 108.
 1865. „ „ De Quatrefages. Annel., t. ii, p. 307.
 1873. „ „ Möbius. Comm. wiss. untersuch. deutsch. Meere Kiel, p. 108.
 1888. „ „ Cunningham and Ramage. Trans. Roy. Soc. Edin., vol. xxxiii, p. 640, pl. xxxvii, figs. 4—4*B*.
 1897. *Pygospio seticornis*, Mesnil. Bull. Soc. France et Belg., p. 85.
 1902. *Spio seticornis*, Leschke. Wiss. Meeres. Kiel, p. 122, pl. vi, figs. 7 and 8.
 1910. „ „ Skorikow. St. Petersburg. Mus. Ann., xv, p. 208.
 1915. *Pygospio seticornis*, Allen. Journ. M. B. A., vol. x, p. 630.
 1917. „ „ Southern, in litt., 1917.
 1920. „ „ Eliason. Polych. Öresund., p. 43, text-fig. 10, *a*, *b*, *c*.
 1922. „ „ McIntosh. Ann. Nat. Hist., ser. 9, vol. ix, p. 17.

Habitat.—In tubes in the middle and upper part of the littoral zone, in clefts of the rocks and under stones in the Firth of Forth (Cunningham and Ramage). In Laminarian roots, Blacksod Bay, dredged in Clew Bay in 7—10 fathoms, and in Bofin Harbour

(Southern). It is abundant between tide-marks, Plymouth, and in clean, hard sand in the estuary at Exmouth (Allen).

Extends to Swedish (Eliason) and northern waters.

Southern observes that this form differs from what he had described in the 'Proceedings of the Royal Irish Academy' as *Spio seticornis*, Fabricus, from Clare Island. In *Pygospio seticornis* the head is bluntly bifid, though when seen laterally it is conical. The branchiæ commence on the first or second segment, and are large about the twelfth or thirteenth. The tail ends in two larger and two smaller cirri, somewhat like *Pygospio elegans*; though in one example the four caudal cirri were about equal. What was sent as a young specimen presented only two ovate lobes at the tail. The anterior bristles are stouter and more boldly curved, with a scoop-shaped lamella in front of them, whilst those at the tail are as usual in the group, and nearly straight. There are five or six tufts of these.

The hooded hooks commence on the seventh bristled segment, and are boldly curved in the anterior region. Eliason shows the ventral bristle of the fiftieth segment as devoid of the granular structure seen in *Spio filicornis*.

Ørsted describes the species as having two series of parallel eyes, the tentacles not alternate, the segments devoid of black pigment; ligulate branchiæ in the middle of the body, but diminishing and disappearing at either extremity. There can be little doubt that Ørsted's form was a *Pygospio*. It is not the *Nereis seticornis* of O. Fabricius.

This form closely resembles *Pygospio elegans*, Claparède, with the exception of the arrangement of the branchiæ, and has been a puzzle to many students of the group. It is in need of careful re-examination. Leschke gives an account of two stages of what he considers to be the pelagic larvæ, which occur likewise in British waters, though their identity has not been satisfactorily tested.

SPIO MARTINENSIS, *Mesnil*, 1896. Plate CXXXVIII, fig. 3—tenth foot; 3a—twentieth foot.

Specific Characters.—Head trilobed, a rounded median lobe projecting in front and supported by two lateral lobes. Two or four eyes at the posterior border. Short median tentacle on the prostomium, and a short median ridge ends posteriorly in a process. Body generally like that of *Spio*, and about 3 cm. long and 1–2 mm. broad, with eighty-five to ninety segments (Mesnil), ending in a dorsal anus with four foliaceous cirri. Colour salmon-tint, with red lines from the blood-vessels, and dark-brown pigment in transverse rows on the segments. First foot bears a ventral tuft of finely tapered bristles with very narrow wings, and a large branchia which overlaps that of the opposite side. Winged hooks appear in the eleventh foot and continue to the posterior end, as do the bristles, and in these the main fang comes off at more than a right angle, and has a single spike above it.

* SYNONYMS.

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|-------|---------------------------|---------|---|
| 1896. | <i>Spio martinensis</i> , | Mesnil. | Bull. Sc. France et Belg., p. 122, pl. vii, figs. 1–20. |
| 1914. | „ | „ | Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 95. |
| 1915. | „ | „ | McIntosh. Ann. Nat. Hist., ser. 8, vol. xv, p. 1. |
| 1917. | „ | „ | Mesnil and Caullery. Compt. Rend., clxv, p. 284. |
| 1920. | „ | „ | McIntosh. Ann. Nat. Hist., ser. 9, vol. ix, p. 17. |

Habitat.—Dublin, Clew and Blacksod Bays, in sand under stones (Southern); shores of France, at St. Martin (Mesnil).

This is a much larger form than *Spio Gattyi*, and the aspect differs. The *head* is characteristically trilobed, a rounded median lobe projecting in front, and supported by two lateral lobes a little further back. Two eyes occur toward the posterior border of the head. In lateral view the snout is bluntly conical, the central or prostomial region being nail-like, and the mouth opening a little behind the tip. A short median tentacle occurs on the prostomium and a brief ridge appears to be continued a short distance backward, to end in a small process or tentacle. The *body* is slightly narrowed anteriorly, is more distinctly diminished posteriorly, and ends in four foliaceous lobes or cirri. It is flattened both dorsally and ventrally, the upper surface carrying the branchiæ, and the ventral surface being marked anteriorly by lines of dark pigment on the tumid region behind the mouth, and with a dark line in the middle of each segment-junction for ten or twelve segments.

The first segment bears a broad sabre-shaped branchia which overlaps its fellow of the opposite side behind the snout. It has a single lobe, the longer margin being inferior, and a tuft of finely tapered bristles which show a narrow margin distally on each side. Above these is a shorter tuft, slightly differing in direction. The second foot has a similar ventral lobe, a tuft of curved bristles, and, in addition, a superior lobe confluent with the branchia, and carrying a tuft of longer bristles finely tapered but less curved distally. At the tenth foot (Plate CXXXVIII, fig. 3) the ventral lamella is elongated vertically with its upper margin deepest, and separated by a narrow cleft from the dorsal, which fuses with the edge of the branchia, the whole forming a broad, flat blade. The bristles have the same structure. At the twentieth foot (Plate CXXXVIII, fig. 3a) the vertical elongation of the ventral lobe is marked, and the lower half bears a row of hooks each of which has a bold curve at the junction of the shaft with the neck, then slightly diminishes upward to the main fang, which makes more than a right angle with the neck, is long and sharp, with a spike above it, and has a wing on each side. The upper dorsal bristles are longer and more slender. At the fortieth foot the branchia is shorter and broader, and the upper group of the bristles much elongated and very finely tapered. The ventral hooks are similar.

Genus NERINIDES, *Mesnil*, 1896.

Prostomium without frontal processes. Branchiæ from the second setigerous segment; dorsal lamella longer than the branchiæ; the ventral division of the foot has no hollow. No hooked dorsal bristles; anal sucker.

NERINIDES LONGIROSTRIS, *De Quatrefages*, 1843. Plate CXXXIII, figs. 18—18b—bristles and hook; Plate CXXXVI, fig. 6—foot, 6a—dorsal bristle.

Specific Characters.—Head acutely pointed, with a median ridge which runs backward to the third segment, and bears four eyes nearly in a square. Two golden yellow and rather short tentacles with a ciliated dorsal groove. Body 10 cm. long and 8 mm. broad, tapered a little anteriorly, more distinctly diminished posteriorly and having the general aspect of

Nerine. Anus dorsal with a sucker-like multilobed ciliated border not surrounded by cirri. Rose-red anteriorly, dull-green posteriorly. Branchiæ commence on the first foot, and continue nearly to the posterior end, the superior lamella forming a border. Both dorsal and ventral divisions of the foot have winged bristles anteriorly, and they continue in the dorsal division to the posterior end. Hooks appear in the ventral division from the thirty-third to the forty-fifth segment, with, at the inferior border, a few simple capillary bristles.

SYNONYMS.

1843. *Malacoceros longirostris*, De Quatrefages. Mag. Zool., p. 12, pl. iii, figs. 7 and 8.
 1865. „ „ Annel., t. i, p. 444.
 1894. *Nerine longirostris*, De St. Joseph. Ann. Sc. nat., 7^e sér., t. xvii, p. 74, pl. iv, figs. 86—90.
 1896. *Nerinides longirostris*, Mesnil. Bull. Sc. France et Belg., t. xxix, p. 152.
 1914. „ „ Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 97.
 1915. „ „ McIntosh. Ann. Nat. Hist., ser. 8, vol. xv, p. 2.
 1922. „ „ idem. Ibid., ser. 9, vol. ix, p. 18.

Habitat.—Blacksod Bay (Southern).

Distribution.—St. Malo (De Quatrefages); ? Ehbien, France (De St. Joseph).

The *head* is acutely pointed, with a median ridge (which runs backward to the third segment), on which four eyes in a square are placed, and the sides have a flattened process (peristomium), from which pass a pair of short tentacles of a golden-yellow colour, and these when separated retain vitality for three days (De St. Joseph). Beneath them is a ciliated groove with pigment-granules, and possibly with urticating elements (De St. Joseph). The tentacles, as in allied forms, aid in procuring nourishment. *Body* 10 cm. long and 8 mm. broad, slightly tapered anteriorly, and more so posteriorly, where it ends in a dorsal anus with a multilobed ciliated border, not surrounded by cirri. The colour is rose-red anteriorly (probably from the blood-vessels), but from the fortieth segment or thereabout the posterior region is dull-green, almost blackish, whilst near the vent the intestine is yellowish, and is usually filled with *Rissoa parva*.

The first segment carries a branchia, and has a dorsal and a ventral division with bristles. There are two lamellæ, the posterior larger than in *N. foliosa* and bordering the branchia. Behind the anterior lamella is a flattened disc with a tuft of bristles similar to the inferior lamella but longer. The general structure of the anterior foot is represented in Plate CXXXVI, fig. 6, and a bristle in Fig. 6*a*, also in Plate CXXXIII, figs. 18 and 18*a*. From the thirty-third to the forty-fifth segment, according to the size of the individual, the inferior division bears two or three bifid and hooded hooks (Plate CXXXIII, fig. 18*b*), which by-and-by increase in number to about twenty, and at the ventral border a few wingless capillary bristles. Simultaneously the posterior lamella forms a margin only to the first part of the branchia, which also is smaller. The feebly winged bristles persist to the posterior end in the dorsal division, but without accompanying hooks. In the last twelve or thirteen segments the branchiæ progressively diminish and disappear.

Mesnil¹ (1896) gave a succinct description of the genus *Nerinides*, which he had established for De St. Joseph's *Nerine longirostris*, thus:—Prostomium without frontal tentacles.

¹ 'Bull. Sc. France et Belg.,' t. xxix, pp. 119–152.

Branchiæ arise on the second bristled segment; dorsal lamella as long as the branchia to which it is attached. No dorsal hooks. Anal sucker.

Mesnil and Caullery¹ (1917) describe this species as dimorphic, some eggs developing to typical Spionid larvæ, whilst others in the spawn-mass develop directly without a pelagic stage. Moreover, in the latter case cannibalism occurs, the authors assigning the title adelphophagy to the condition (the pœcilogony of Giard). De St. Joseph met with *Trichodina pediculus* as a parasite on the branchiæ; whilst in the interior of the branchiæ and the tentacles he found encysted Distomes, which might have been introduced by the Rissoæ.

NERINIDES TRIDENTATA, *Southern*, 1914. Plate CXXXIII, fig. 19—hook; Plate CXXXVI, fig. 7—tenth foot.

Specific Characters.—Head spindle-shaped, an occipital tentacle posteriorly; eyes two pairs, arranged nearly in a transverse line. Peristomial segment forms a translucent lobe on each side, grooved ventrally. Tentacles short, thick, deep chocolate. Body resembling *Spio*, small, attaining its greatest width anteriorly, and gradually tapering to the slender tail, which ends in a bilobed flattened process. The first setigerous segment carries only a ventral tuft of capillary bristles. The second foot has a dorsal lamella fused with the branchia, and longer dorsal bristles. The ventral lamella bears shorter capillary bristles. Shorter bristles with wide and dotted tips and striated shafts occur both dorsally and ventrally after the tenth foot. Bifid winged hooks appear in the ventral division about the fifteenth foot, with a large main fang, which leaves the neck nearly at a right angle, and has two spikes in lateral view on the crown above it.

SYNONYMS.

1914. *Nerinides tridentata*, Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 98, pl. x, fig. 23 A—J.
 1915. „ „ McIntosh. Ann. Nat. Hist., ser. 8, vol. xv, p. 2.
 1922. „ „ idem. Ibid., ser. 9, vol. ix, p. 20.

Habitat.—Blacksod Bay in Laminarian roots (Southern). The *snout* is pointed, with a median ridge, which in lateral view forms two divisions—an anterior less elevated, and a posterior terminating in the more or less adnate tentacle. In the line between the two divisions are the four black eyes arranged in a transverse row. The mouth opens inferiorly, and the extruded proboscis is bell-shaped and smooth. The tentacles were absent in the example kindly sent by Mr. Southern, but he describes them as “short, thick, and firmly adherent, of a deep chocolate colour.”

The *body* is nearly an inch in length (16—20 mm.) in life, tapered a little in front and more distinctly diminished posteriorly, where it terminates in two small rounded lobes, a slight dorsal process indicating the upper edge of the anus. Segments 61—70 short anteriorly, wider in the middle region. Dorsal surface flattened, ventral rounded.

The first foot has a small conical papilla or cirrus, and a single (ventral) tuft of trans-

¹ ‘Compt. Rend.,’ clxv, p. 284.

lucent bristles with a well-marked curve at the commencement of the tip. If wings are present, they are very narrow. The second foot bears dorsally a small branchia curved inward, the dorsal lamella being fused to it, and ending inferiorly in a truncate edge. A tuft of finely tapered translucent bristles spreads like a fan upward and outward. The upper bristles of the tuft are longer and more delicately tapered, and the wings in these are less distinct than in the shorter and thicker forms at the lower edge. The inferior division has a bluntly rounded lamella and a shorter tuft of bristles, with traces of wings. At the tenth foot (Plate CXXXVI, fig. 7) the branchia is larger, forming a broad, flat curved process, the soldered lamella of the superior lobe ending inferiorly in an edge which projects less than the upper margin of the ventral lamella. The dorsal tuft of bristles has the same structure as in the second, only they are in two rows, are longer and stronger, and the tips less elongated. The lamella of the inferior division has increased in depth, and the bristles are proportionally longer and still stouter than the dorsal. Both tufts have a distal curve. Southern describes a group of three slender striated setæ on the lower margin of the ventral bundle.

Hooks appear in the ventral division of the fifteenth or sixteenth foot. At the twentieth foot the branchia retains a similar shape and is still large, with the dorsal lamella on its outer edge. The bristles are similar to those in front. Ventrally the lamella has much increased in depth and is separated only by a short gap from the dorsal, where its breadth is greatest, for it diminishes ventrally. From its lower edge fully half its border is occupied by hooks, which are closely arranged inferiorly, but have more space superiorly.

The shaft of the hook (Plate CXXXIII, fig. 19) dilates from the base upward to the bold forward curvature, then it slightly diminishes to the neck, from which the proportionally large main fang comes off at a little more than a right angle. A single spike (in lateral view) occurs on the crown. Distinct wings guard the tip of the hook, which is thus in reality hooded. The lamellæ of the feet are most prominent in the posterior part of the body, and thus differ from those of *N. longirostris*, and the latter lives in clear sand, whereas *N. tridentata* frequents laminarian roots (Southern).

SCOLECOLEPIS LAMELLATA, *McIntosh*. Plate XCVI, figs. 8 and 8a—tenth and fiftieth feet.

In the 'Annals of Natural History'¹ a form from the "Porcupine" Expedition of 1869 was alluded to under the title of *Scolecoplepis* (I.). This has now been definitely termed *S. lamellata*, McIntosh.

Specific Characters.—Head with an even transverse margin in front, a short, blunt tentacle at each angle, and from the centre a short, elevated region proceeds backward, to end in a small process, which is pointed posteriorly like an adherent tentacle. Minute eyes seem to be present on each side of the latter, but the condition of the specimen renders accurate determination uncertain. The whole region is short, and the proboscis is thrust out as a short cylinder with a crenate margin. Body fragmentary, flattened, slightly and abruptly tapered anteriorly, and with a median band ventrally. The segments are narrow and numerous. The first foot carries a subulate branchia and a large, lanceolate lamella

¹ Ser. 8, vol. iii, February, 1909, p. 176.

projecting freely upward nearly as far as the branchia. The latter remains subulate at the fiftieth foot. Dorsal bristles of the first foot slender, long and finely tapered, and the ventral are also long and slender. Behind the tenth foot the bristles are similar and of a dull golden colour. The ventral bristles form two groups, viz., upper finely tapered forms, and a lower series of shorter, broader bristles overlapping the former, and with acute tips.

At the fiftieth foot a notch separates the two divisions; and the modified ventral bristles have a sharp and slightly hooked point minutely dotted under a high power.

In Plate XCVI the tenth foot is drawn in fig. 8, and the fiftieth foot in fig. 8*a*, whilst a bristle is shown in Plate CV, fig. 6. Remarks on the species are made on p. 167 of vol. iii, Part I, of this Monograph.

A fragmentary form, yet with such definite characters as to render its identification easy.

The first foot carries a subulate branchia and a large lanceolate lamella. The ventral division also has a lanceolate process, and the bristles in both are long and slender. From the shape of the body the lamellæ and bristles occupy the dorso-lateral edge, so that the branchiæ, which readily fall off, pass transversely inward over the flattened dorsum. At the tenth foot the ventral lamella forms a broad, almost semicircular flap, with a tendency to a peak inferiorly. The ventral series of shorter, broader bristles overlaps the finely tapered forms stretching outward along the lamella.

The branchiæ remain subulate at the twenty-fifth foot, and stretch beyond the elongated upper lamella, which is acutely lanceolate superiorly, its outer edge being comparatively even till it curves inward inferiorly. The ventral lamella forms a blunt flap, with the bristles in the groups just mentioned. At the fiftieth foot (Plate XCVI, fig. 8*a*) the branchia is still rather long and subulate, and the upper lamella is prominent and rounded inferiorly, whilst superiorly it is acutely lanceolate. The upper bristles of the dorsal series are long, slender and finely tapered. A notch separates the two divisions of the foot. The ventral lamella is also prominent and rounded, generally with a short peak. The modified bristles ventrally show a sharp and slightly hooked point, minutely dotted under a high power. No wings are visible in either dorsal or ventral bristles.

SYNONYMS.

1909. *Scolecolepis*, I. McIntosh. Ann. Nat. Hist., ser. 8, vol. iii, p. 176.
 1922. „ *lamellata*, idem. Ibid., ser. 9, vol. ix, p. 21.

AONIDES PAUCIBRANCHIATA, *Southern*, 1914. Plate CXXXVI, fig. 8—anterior foot; fig. 8*a*—bristle.

Specific Characters.—Snout acute, but less abruptly so than in *A. oxycephala*, and prolonged backward, to end in a peak. Four kidney-shaped eyes with lenses occur posteriorly, the anterior pair having a larger space between them. Body of a similar form, though much smaller than *A. oxycephala*; segments fifty to eighty; only ten (or eleven) pairs of branchiæ anteriorly. Feet resemble those of the common species. Bristles not dotted. Hooks commence on the thirty-sixth foot, with two spines above the great fang. Two pairs of anal cirri, the ventral being the shorter, whereas *A. oxycephala* has two lateral plates on each side

of the anus, and each plate has three to five cirri, usually four. Behind the eleventh foot the lamellæ increase greatly in size, but are inconspicuous posteriorly. Mature in May.

SYNONYMS.

1914. *Aonides paucibranchiata*, Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 100, pl. xi, figs. 24 *a—e*.
 1915. „ „ McIntosh. Ann. Nat. Hist., ser 8, vol. xv, p. 3.
 1922. „ „ idem. Ibid., ser. 9, vol. ix, p. 22.

Habitat.—Dredged in Clew Bay in 24 fathoms, and Berehaven (Southern).

The *snout* is acute, though less abruptly so than in *A. oxycephala*, and it is prolonged backward, to end in a peak. Four eyes occur posteriorly, the anterior pair having a larger space between them. The *body*, though much smaller, has a similar form to that of *A. oxycephala*, and it bears about ten gills anteriorly, the branchial region being thus different from that of the common form, in which the gills appear to be closer in the preparations, though that may be caused by the methods adopted in preservation. An anterior foot is outlined in Plate CXXXVI, fig. 8, and typical bristle in fig. 8*a*. In the seventy-eighth foot the dorsal division contains four hooks and six capillary setæ. The ventral division has seven hooks and four capillary bristles, the two central being longer and stouter than the others. The lamellæ have long, finger-shaped, amber-coloured glands.

The tail of *A. oxycephala*, in the examples from Herm, is small and has dorsally two short conical lobes, whilst beneath are about eight smaller conical cirri, whereas in this species there are but two pairs of anal cirri.

POLYDORA CÆCA, *Ørsted*. Plate CXXVI, fig. 11—hook; Plate CXXXVI, fig. 9—dorsal bristle; Plate CXXXVIII, fig. 10—hook of the fifth segment, 10*a* and 10*b*—bristles.

Specific Characters.—Head similar to that of *P. flava*, with a bifid median process, which is continued backward to the second segment. Body fully 20 mm. long, and having from 70 to 120 segments, terminating in a caudal funnel, with a hiatus superiorly. Fifth segment bears strong acicular bristles, with a distinct hook at the tip, but no spur. Branchiæ commence on the eighth setigerous segment, and terminate, as a rule, about the fiftieth. About the twenty-fifth segment, in front of the caudal funnel, stout acicular bristles appear in the dorsal tuft and continue almost to the tip of the tail.

SYNONYMS.

1843. *Leucodorum cæcum*, *Ørsted*. Annul. Danic. Consp., p. 39.
 1844. „ „ idem. Arch. f. Naturges., p. 106, pl. ii, figs. 13—16.
 „ „ „ idem. Reg. Mar., p. 78.
 1865. *Leucodore cæca*, De Quatrefages. Annel., t. ii, p. 302.
 1867. „ *cæcus*, Malmgren. Annul. Polych., p. 95.
 1870. *Polydora flava*, Claparède. Suppl. Annél. Naples, p. 123.
 1873. *Leucodora cæca*, Willemoes-Suhm. Zeitschr. f. wiss. Zool., Bd. xxiii, p. 348, pl. xviii, figs. 4—5.
 1874. *Leipoceras uviferum*, Möbius. 2^e deutsche Nordpolarfahrt, ii, p. 254, pl. i, figs. 10—20.
 1879. *Polydora cæca*, Webster. Annel. Virgin. Coast, p. 52, pl. ix, figs. 119—122.
 1880. „ *ciliata*, var. *minuta*, Langerhans. Zeitschr. f. wiss. Zool., Bd. xxxiv, p. 91.

1893. *Polydora flava*, Carazzi. Mitt. Zool. Stat. Neapel., Bd. xi, p. 22, pl. ii, figs. 9 and 10.
 „ „ „ Lo Bianco. Atti Accad. Sc. Nap., ser. 2, vol. v, p. 31.
 „ „ *cæca*, Mesnil. Comp. Rend. Acad. Sc. Paris, p. 643.
 1894. „ „ De St. Joseph. Ann. Sc. nat., 7^e sér., t. xvii, p. 50, pl. iii, figs. 65—70.
 „ *Leucodore* „ Hornell. Nature, vol. xlvii, p. 78.
 1896. *Polydora* „ Mesnil. Bull. Sc. France Belg., t. xxix, p. 191, pl. xii, figs. 23—29.
 1914. „ „ Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 103.
 „ „ „ Fauvel. Annél. Polych. Monaco, p. 219.
 1915. „ „ McIntosh. Ann. Nat. Hist., ser. 8, vol. xv, p. 3.
 „ „ „ Allen. Journ. M. B. A., vol. x, p. 630.
 1920. „ „ Eliason. Polych. Öresund, p. 46, text-figs. 12 *a—e*.

Habitat.—Specimens kindly forwarded by Southern from Blacksod Bay, Ireland; shore collection, Plymouth (Allen).

It occurs in Norway (Ersted); Mediterranean (Lo Bianco); shores of France, in tubes on oysters (De St. Joseph), and under Lithothamnion (Mesnil); Farøe (Willemoes-Suhm); Arctic Sea, Swedish waters (Eliason).

The *head* is similar to that of *Polydora flava*, with a bifid median process, which is continued backward as a keel to the second segment, whilst the broad peristomial lobes support it laterally. The long tentacles have a deep, ciliated groove and readily fall off.

The *body* reaches 20 mm. in length, has from fifty to ninety segments, and terminates posteriorly in a sucker. It is colourless, or slightly yellowish. The second, third, fourth and sixth segments have a short cirrus and a tuft of simple winged bristles (Plate CXXXVIII, fig. 10*b*). The fifth segment has strong acicular bristles or hooks (Plate CXXXVIII, fig. 10), with a distinct hook at the tip, but, as in *P. flava*, no spur. The tips of those hooks in the tissues are sharp, whereas those exposed are blunt. The concavity of the hook further shows in lateral view a double outline as if a flattening or hollowing of the surface were present. This is observed even in the developing forms, where only the tip exists, and is therefore an original character. It bears as usual a dorsal and a ventral tuft of capillary winged bristles.

Along with the powerful acicular bristles are minute oar-shaped forms (Plate CXXXVIII, fig. 10*a*) with short, delicately pointed tips. The seventh segment has glandular pouches and a dorsal branchia, and whilst the winged capillary bristles continue dorsally (Plate CXXXVI, fig. 9), hooks occur ventrally. Moreover in the seventh, eighth and ninth segments and the last three is a simple bristle much longer and finer than the ordinary forms. The branchiæ continue to the fifty-eighth segment in an example with ninety-eight segments (De St. Joseph). The glandular pouches cease from the thirteenth to the fifteenth segment (De St. Joseph). About the twenty-fifth segment, in front of the sucker, stout acicular bristles appear in the dorsal tuft, and continue almost to the tip of the tail, and this feature and the comparative strength of the bristles (Plate CXXXVIII, figs. 10 and 10*a*) of the region generally make a contrast with those of *Polydora ciliata*, where they are both very long and very slender. Mesnil observes that they are less developed than those of *P. Giardi*.

The bristles of the posterior region, indeed from the fiftieth segment backward, are distinguished by their great strength and comparative shortness. Several of the shorter in each tuft terminate a little beyond the skin in stout, pointed tips like spines. In many

of the tufts three or four of these shorter accompany two or three longer forms with attenuate and slightly bent tips with very narrow wings. The appearance of these shorter bristles indicates that they are simply modifications of the shorter winged forms in the closely allied *P. flava*. No packets of fine bristles (in the tissues) occur in this species as in *P. ciliata* and *P. flava*.

The hooks (Plate CXXXVIII, fig. 10), as a rule, are only two in number: the main fang makes a larger angle with the neck than in *P. flava*. The segmental organs are coloured brownish-green (Mesnil).

De St. Joseph describes an enlargement of the alimentary canal from the fifteenth to the twentieth segment, with thick muscular walls like a gizzard, as indeed Marion had formerly mentioned apparently in the same species. This is probably the pharynx of Mesnil. The bundles of fine bristles, so conspicuous in *P. ciliata*, are absent.

Ersted says¹—“*Leucodorum cæcum* 1½" longo, ¾" lato, rubescens, 70—80 segmentis constante; anterioribus segmentis 3-plo latoribus quam longis, posterioribus, vero duplum longioribus granulatus, rostro capitis in duos acuminatas productus, oculis nullis, appendicibus tentacularibus acuminatis, segmento quinto aciculis 6—7 præditi.

“In freto Öresund prope inulam Hseen in fundo argillacio.”

The habitat of *P. cæca* seems to be different, for it is chiefly a northern form, whilst *P. flava* is more a southern type.

Hornell found at Jersey numerous examples with their tubes imbedded in a sponge (*Microciona plumosa*, Bowerbank), even so many as forty in a square inch. He does not mention the structure to which the sponge was attached, nor whether the tubes were solely in the sponge, but the observation is interesting.

POLYDORA GIARDI, *Mesnil*. Plate CXXXVIII, figs. 11 and 11a—large hooks of the fifth foot.

This was represented by a single compressed and more or less dried example kindly sent by Mr. Southern. Procured in laminarian roots, Blacksod Bay, March 15th, 1911.

Externally it shows the frontal lobes of the median process as two conspicuous leaf-like projections, which differ from those of the ordinary adult *P. ciliata*. The branchiæ in this small specimen appeared to be large and flattened, commencing on the seventh or eighth bristled segment, but as the specimen was ruptured their exact distribution could not be made out. The hooks of the fifth foot seem to have a proportionally longer process than in *P. ciliata* below the terminal curve (Plate CXXXVIII, figs. 11 and 11a). The posterior bristles are in the usual two groups, a longer series with slightly curved and finely tapered tips and narrow wings, and a shorter series with broader wings and tips, which also are slightly curved. Those projecting through the skin resemble spines.

POLYDORA HOPLURA, *Claparède*.

At least eighteen posterior segments have the powerful chitinous ventral hooks, the first of the series being smaller and less curved, and the terminal also being smaller, though

¹ ‘Annul. Dan. Consp.’ p. 39.

also curved. The most powerful are those intermediate in position, especially in front, and they are continued to the segment in front of the terminal sucker.

Each foot in this region has dorsally a short branchia, a tuft of two or three proportionally long, slender capillary bristles with traces of wings, and the powerful ventral hook (Plate CI, fig. 10), which is boldly curved and sharp at the tip, swells out below into a stout shaft, and then diminishes a little toward the base. It is longitudinally striated internally and marked by transverse streaks, and, though hard, is brittle. A comparatively large species, measuring more than an inch in length— $1\frac{1}{8}$ or $1\frac{1}{4}$ inches. Snout with the median process and lateral supports. The median forms a kind of keel for some distance backward, and showed in the preparation from Ireland little tendency to be bifid. When viewed antero-posteriorly the wings touch the crown of the ordinary hook on each side. The branchiæ are large from the tenth backward, diminish toward the posterior third, and on the tail form short processes or papillæ. The caudal sucker has the usual gap superiorly, but is smoothly rounded throughout the rest of its border. Each branchia has an afferent and an efferent vessel.

From Ardfry, on oysters, October 9th, 1904. Ireland (Southern).

MAGELONA ROSEA, Moore, 1907.

Specific Characters.—Prostomium and peristomium are coalesced to form the broad ovoid head (in spirit), with dorsal cephalic ridges tapering to acute points, which diverge anteriorly. Peristomium with prominent lateral lobes; tentacular cirri arising laterally with papillæ, which increase in length distally. Proboscis soft, bulbous, with parallel striæ. Body slender, depressed, tapering and sub-quadrate anteriorly; body 40 mm. long; segments about ninety-five. Ninth bristled segment with tapering simple bristles. Pygidium small, oblique, with anus dorsal, covered by a broad, flat papilla, and posteriorly with a pair of small slender cirri. Colour translucent white, intestine buff or greenish-brown, pharynx salmon-pink. In sand at and below low water. Nearly ripe in August.

SYNONYMS.

1907. *Magelona rosea*, Moore. Proc. Acad. N.S. Philad., p. 201.
 1914. „ „ Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 105, pl. xvi, fig. 24.
 1920. „ „ Eliason. Polych. Öresund, p. 52.
 1922. „ „ McIntosh. Ann. Nat. Hist., ser. 9, vol. ix, p. 23.

Habitat.—Dredged in 7 fathoms in Killary Harbour, in mud (Southern).¹

Distribution.—Wood's Hole, Mass. (Percy Moore), Swedish waters (Eliason).

The larvæ have been described by Fewkes as *Prionospio tenuis*, from Newport, and by Andrews, from Beaufort, N.C., and Wood's Hole.

¹ Unfortunately the specimen sent by Mr. Southern had no ninth segment.

FAMILY CIRRATULIDÆ.

CIRRATULUS MCINTOSHI, *Southern*, 1914. Plate CXXX, figs. 11 and 11a—tail and bristles.

Specific Characters.—Head a small blunt cone, sometimes constricted posteriorly, and in extrusion of the proboscis it projects upward and forward, or in complete extrusion upward. Body probably between 1 and 2 inches long, flattened anteriorly, and somewhat rounded posteriorly. It is tapered rather abruptly anteriorly, but posteriorly only slight diminution occurs, the body terminating in a pouting, button-shaped vent, produced ventrally into a process with a median fissure and a fillet on each side. The ventral surface is flattened, sometimes with a median ridge and two lateral elevations. The buccal and two achæous segments follow the head. Long, slender branchiæ arise from the dorsal edge of fully twenty of the anterior feet. Anterior segments narrow, posteriorly they are broader, and the number may be seventy to a hundred. Foot (typical) with a dorsal and a ventral setigerous process, each bearing a tuft of capillary bristles, the tips being slightly flattened at the somewhat narrow base, and tapering to hair-like extremities, the dorsal one the longer. Well developed ova in July.

SYNONYMS.

1911. *Cirratulus norvegicus*? McIntosh. Ann. Nat. Hist., ser. 8, vol. vii, p. 171, pl. vii, figs. 12 and 12 a.
 1914. „ *Macintoshi*, Southern. Proc. Roy. Irish. Acad., vol. xxxi, No. 47, p. 110.
 1922. „ „ McIntosh. Ann. Nat. Hist., ser. 9, vol. ix, p. 23.

Habitat.—Dredged in Inishlyre Harbour, Killary Harbour, Bofin Harbour, and Clew Bay (Southern).

Distribution.—Dredged in 30—100 fathoms off Drobak, Christiania Fjord (A. M. N.).

The head has the form of a small, blunt cone, sometimes contracted posteriorly, and when the button-shaped proboscis is extruded, as in the majority, it projects upward and forward, or, in complete extrusion, upward. The gaping mouth has a considerable amount of dark pigment.

The body is probably between 1 and 2 inches in length, flattened anteriorly, and somewhat rounded posteriorly. It is tapered rather abruptly anteriorly, but does not appear to be much tapered posteriorly, only a slight diminution taking place in the preparation; but such may be an incomplete specimen. It terminates posteriorly in a pouting button-shaped vent, which is produced ventrally into a process with a median fissure and a fillet on each side of it (Plate CXXX, fig. 11). The ventral surface is flattened, sometimes with a median ridge and two lateral elevations, though in a few neither is visible. The buccal and two achæous segments follow the head, and in one example each has a dorso-lateral frill—it may be from imperfect preservation. Every example presents two short lappets (or, it may be, the bases of tentacles) interposed between the converging lateral lines of the feet nearly opposite the first bristle-bundles. A series of long, slender branchiæ project from the dorsal edge of more than twenty of the anterior feet, and traces appeared in some considerably behind these. The anterior segments are closely arranged, but posteriorly

they are a little less so, and the number is probably from seventy to one hundred, though no specimen is complete.

Some had well-developed ova in July.

The structure of the feet throughout is the same, viz., a dorsal and a ventral setigerous process, each having a tuft of translucent pale yellow capillary bristles (Plate CXXX, fig. 11*a*), the tips being slightly flattened at the somewhat narrow base, and tapering to delicate hair-like extremities. The dorsal are the longer, and they increase in length toward the middle of the body, and remain of considerable length posteriorly, where the distinction between the more slender and longer dorsal and the shorter and proportionally broader ventral is maintained. A curious series of coiled tubes (?) occurs posteriorly.

It is interesting to find this Norwegian species in British waters. Truly the riches of the marine fauna of the West Coast of Ireland are by no means exhausted, especially in regard to the Marine Polychæts.

CIRRATULUS CHIAJII, *McIntosh*, 1922.

Cirratulus chiajii, McIntosh, has been subsequently described as *Cirratulus norvegicus*, De Quatrefages, but Delle Chiaje had long before termed it *Lumbricus filigerus* and *Cirratulus filigerus*, so that, if priority held, such would be its title. It is perhaps doing no injustice to De Quatrefages or other author by giving it the title *C. chiajii* after its early investigator.

CIRRATULUS INCERTUS, *McIntosh*. Plate CXXXVII, fig. 9.

In the Monograph of the British Marine Annelids¹ ambiguity was caused by the use of the specific name *bioculatus* for a Cirratulid dredged in the Zetlandic Seas by Dr. Gwyn Jeffreys, the name *bioculatus* having been applied by Keferstein² to another Cirratulid differing from this in several particulars. The species is small, and it is unknown whether it is a young or an adult form, only a single example having been obtained, and it measures about $\frac{5}{8}$ of an inch in spirit, its diameter being about 1 mm. The general aspect (Plate CXXXVII, fig. 9) is indicated in the sketch, though the eyes have now disappeared. The segments are about fifty-five in number. The head shows less of a basal constriction than usual in examples of *Cirratulus cirratus* of the same size. The cirri from the fourth segment are of great length, probably reaching in life beyond the tip of the tail. The latter has a similar termination to that of *C. cirratus*, the ventral papilla being the more prominent. The caudal region thus diverges from Keferstein's *C. bioculatus*, which possesses two well-marked caudal cirri.

The dorsal capillary bristles in front are of considerable length, and shorter forms are continued behind these. Thus at the tenth foot the long, slender tuft of finely tapered capillary bristles, with a slight curvature at the tip,³ occupies the dorsal division, whilst the ventral series consists of bristles having short, cylindrical shafts, which expand into knife-

¹ Vol. iii, part i, Text, p. 253.

² 'Zeitschr. f. wiss. Zool.,' Bd. xii, p. 121, Taf. x, figs. 23—27.

³ 'Monograph,' pl. ciii, fig. 16.

blade-like tips finely tapered at the extremity, five being fully developed. About the twentieth foot the dorsal bristles are shorter but retain the same character, and by-and-by hooks appear in this division. In the ventral division they are at first accompanied by a bristle—indeed, occasionally a bristle is found in the dorsal division with the hooks¹ posteriorly. The hooks thus correspond with those of *Cirratulus*, and differ from Keferstein's species or any allied form with the bifid hooks.²

I am indebted to Mr. Southern, who has specially worked at the Cirratulids, for drawing my attention to the ambiguity of the title in the Monograph. It had escaped observation. A reference to the figure of the hook in the Monograph will show that it cannot be confounded with Keferstein's species.

CHÆTOZONE ALATA, *Southern*, 1914. Plate CXXXVI, fig. 15—hook.

Specific Characters.—Head conical; a pair of dark, deeply-imbedded eyes. Tentacles large, each accompanied by a lateral cirrus. Body slender, 10—12 mm. long, and having 110 segments, tapering at each end, especially posteriorly. Capillary bristles in all the dorsal tufts, the longer cylindrical, without flattening of the tips, shorter with flattened tips. Capillary bristles also occur in all the ventral tufts. Hooks appear in the twenty-first setigerous segment, and they are present in all the ventral divisions. They are bifid and boldly curved, as well as winged.

SYNONYM.

1914. *Chætozone alata*, Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 112, pl. xii, fig. 27a—d.

Habitat.—Blacksod Bay, in Laminarian roots, and at the surface in Ballinakill Harbour at night.

The *head* is conical, with two dark eyes deeply imbedded on the dorsum of the head, probably on the brain (Southern). Dorsal tentacles large, reaching 2 mm. in length.

Body slender, uniform in width, tapering a little at each end, especially posteriorly. Segments 100 to 110. Dorsal tentacles large, attaining a length of 2 mm., arising in front of the first setigerous segment, each accompanied by a lateral cirrus. Capillary bristles are present in all the dorsal tufts; the longer ones being slender and cylindrical, with tapered tips, the shorter with flattened blades and thin along one edge. Hooks appear dorsally on the twenty-first bristled segment. The number of the capillary bristles decreases posteriorly, only one occurring in the segments near the tail. Hooks (Plate CXXXVI, fig. 15) are present in all the ventral divisions, and anteriorly two very slender capillary bristles accompany them. They are bifid and boldly curved, with a shoulder where they pierce the skin; the distal region has a narrow wing (hood), which appears like a margin posteriorly, and the shaft is slightly striated. They increase in size posteriorly, and the slender capillary bristles accompanying them are often absent. The number of both hooks and bristles diminishes posteriorly. All the examples were immature.

Southern, from whose description much of the foregoing has been taken, considers

¹ Ibid., pl. cv, fig. 19.

² Ibid., pl. cv, fig. 18.

that it is most nearly allied to *C. viridis*, Langerhans, from which it is distinguished by the presence of hooks in all the ventral bundles (they are absent in *C. viridis* in the two anterior bundles); by the shape of the hooks, and, he says, the absence of a wing or hood in *C. viridis*—a feature probably requiring further investigation; and, lastly, by the presence of capillary bristles in all in the ventral series.

CHÆTOZONE KILLARIENSIS, *Southern*. Plate CXXXVI, fig. 13—bristle.

Specific Characters.—Head conical; no eyes. Dorsal tentacles in front of the first bristled segment, each of which has a lateral cirrus externally. Body 11 mm. long, and with eighty-four bristled segments; widest in the anterior third, rapidly tapered anteriorly, and gradually so posteriorly, where it terminates in a dorsal anus with a ventral lobe beneath. Dorsal cirri fixed above the bristles. In the middle and anterior regions both dorsal and ventral divisions of the foot have only capillary bristles. Hooks appear ventrally in the fifty-sixth segment, and dorsally in the sixty-first. The dorsal hooks resemble short, flattened bristles with curved tips, and the uppermost dorsal hook is the largest. The main fang and the spike above are widely divergent.

SYNONYM.

1914. *Chætozone Killariensis*, *Southern*. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 113, pl. xii, fig. 28 A—F.

Habitat.—A minute form (young?). Dredged in Killary Harbour in 7 fathoms, in rich, black mud (*Southern*).

Head pointed. *Body* about 11 mm. in length, widest in the anterior third, tapering abruptly toward the head and more gradually to the tail, the anus being dorsal, with a smoothly rounded lobe beneath. Bristled segments eighty-four in the largest example. Dorsal tentacles on the segment in front of the first setigerous segment, and each is accompanied externally by a lateral cirrus above the dorsal bristles. In the middle region both dorsal and ventral divisions of the foot have capillary bristles, the dorsal being longer than the ventral, long and short bristles, however, occurring in each tuft. The dorsal bristles (Plate CXXXVI, fig. 13) are longest between the twentieth and thirtieth segments, after which they gradually decrease in length. The shorter bristles anteriorly have a cylindrical shaft and a flattened tip, with a distinct curve at the junction.

In the largest example the first ventral hook appears in the fifty-sixth segment, and the first dorsal in the sixty-first (*Southern*). In the caudal segments all the capillary bristles of the ventral bundle may be replaced by hooks.

The dorsal hooks resemble the short capillary bristles in outline, except that the tip is curved and bifid, the upper hook in the dorsal division is much larger than the others in either division, and the upper in the ventral is similarly conspicuous. Most of the examples except one were immature.

It resembles the young of *Chætozone zetlandica*, from which it differs in having no eyes, in having hooks in the posterior dorsal bundles, in the relative position, size and shape of the bristles, etc. (*Southern*).

MACROCHÆTA CLAVICORNIS, Sars, 1835. Plate CXXXVI, fig. 14—dorsal bristle, and 14*a* and 14*b*—compound hook-like bristles; Plate CXXXVII, fig. 7—enlarged view of body; Plate CXXXVIII, fig. 12—processes of the surface of the body.

Specific Characters.—Head distinctly defined, with a median process to the blunt snout, and four dark eyes arranged nearly transversely, the larger being external. Two clavate palpi from the peristomial segment. Four pairs of somewhat clavate cirri from the next four segments. Body from 0·75 to 1 cm., somewhat spindle-shaped in spirit and densely covered with papillæ. Tufts of long translucent bristles with minute spines occur dorsally; ventrally are peculiar flattened, large transparent and articulated hooks, with bifid tips.

SYNONYMS.

1835. *Nais clavicornis*, Sars. Beskriv. og. Jagt., p. 64, pl. ix, fig. 24 *a—d*.
 1851. *Macrochæta clavicornis*, Grube. Fam. Annel., p. 64.
 1880. „ „ Langerhans. Zeitschr. f. wiss. Zool., Bd. xxxiv, p. 95, Taf. i, fig. 7.
 1883. „ „ Levinsen. Vid. Meddel. naturh. Forh. Copenhagen, 1883, p. 298.
 1894. „ „ Bidentkap. Forhandl. Vidensk. Selsk. Christ., p. 94.
 1898. „ „ Caullery and Mesnil. Annel. Univ. Lyon, Fasc. xxxix, p. 130.
 1914. „ „ Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 120.
 „ „ „ Fauvel. Annél. Polych. Monaco, p. 21.
 1922. „ „ McIntosh. Ann. Nat. Hist., ser. 9, vol. ix, p. 24.

Habitat.—Blacksod Bay in corallines; in Laminarian roots on the shores and dredged in a few fathoms in the former and in Clew Bay; Ballynakill Harbour (Southern).

Distribution.—Norway (Sars); Madeira (Langerhans).

In general aspect (Plate CXXXVII, fig. 14) at first sight this form resembles a Chloræmid, and it has a densely papillose skin, and long, slightly spinose bristles. The papillæ agree in minute structure with those of the Chloræmids, and mud and sand occur in the interstices. Its phosphorescence, however, is a feature at variance with that group, and more in consonance with the Syllids. The pigmented anterior region ends bluntly, with a median process (somewhat like the central apparatus of *Stylarioides arenosa*), but the other parts diverge. The four eyes, arranged nearly in a square, are very distinct.

The simple, spinous dorsal bristles (Plate CXXXVI, fig. 14) differ from those seen in various groups, and notably from those present in certain Syllids, and are slender elongated forms tapering to a hair-like point. The anterior and posterior hooks, or compound hook-like bristles, do not differ much from each other, both having the tip strongly curved and pointed (Plate CXXXVI, figs. 14*a* and 14*b*), with a wing-like process also with an acute tip. The papillæ on the body (Plate CXXXVIII, fig. 12) differ from those usually seen in the Chloræmids, and lean to a type *sui generis*, for such appendages are unknown in the Syllids proper.

The example, kindly sent by Mr. Southern, is mature, since the posterior region had many large ova. The alimentary canal harboured Opalinæ with two vacuoles.

Marion and Bobretzky¹ (1875) describe *Heterocirrus frontifilis*, Grube, from Marseilles, which, in many respects, agrees with *Macrochæta*.

¹ 'Ann. Sc. nat.,' 6^e sér., t. ii, p. 64, pl. viii, fig. 18, and pl. ix, fig. 18.

FAMILY HALELMINTHIDÆ.

NOTOMASTUS RUBICUNDUS, *Keferstein*, 1862. Plate CXXXVI, fig. 16—anterior hook.

Specific Characters.—The cephalic region is conical, with four larger eye-specks and two groups of smaller eyes in front, a lobulated nuchal organ on each side. Body 10 cm. long and 2 mm. broad, vermiform, slightly enlarged anteriorly about the sixth segment, tapered posteriorly, and ending in a button-shaped tail, all with neural parapodia, and dorsal parapodial gills (Eisig). Genital opening at the fifth pair, and two in the sixth. Thorax reddish, abdomen brownish or yellowish-green, or bluish-green posteriorly. Bristles simple winged, tapering, eleven pairs. Abdominal hooks with four teeth in lateral view, from the thirteenth segment backward. Mature from December till May.

SYNONYMS.

1862. *Capitella rubicunda*, Keferstein. Zeitschr. f. wiss. Zool., Bd. xii, p. 123, Taf. xi, figs. 7—18.
 1864. *Notomastus Benedeni*, Claparède. Glanures, p. 54, pl. iv, fig. 9.
 1868. *Capitella rubicunda*, idem. Annel. Neap., p. 27.
 „ ? *Notomastus lineatus*, idem. Ibid., p. 278, pl. xxvii, fig. 4.
 1887. *Capitella rubicunda*, Eisig. Capitell., p. 863, Taf. xxxv, figs. 17 and 23; Taf. xxxv, fig. 20; Taf. xxiii, fig. 4; Taf. i, fig. 1 c.
 1915. *Notomastus rubicundus*, Allen. Journ. M. B. A., vol. x, p. 637.
 1922. „ „ McIntosh. Ann. Nat. Hist., ser. 9, vol. ix, p. 24.

Habitat.—In fine clean sand off the Yealm Estuary, Plymouth (Allen).

This was considered to be the young of *N. latericeus*, but Allen says its habits differ, *H. rubicundus* never protruding its proboscis.

Distribution.—St. Vaast-la-Hougue (Keferstein); Port Vendres (Claparède); Mediterranean (Eisig).

An anterior hook is drawn in Plate CXXXVI, fig. 16.

Keferstein, who discovered this species at St. Vaast-la-Hougue, gives a detailed description of its structure. The body measures 250 mm., and is divided into an anterior and a posterior region, the latter commencing at the twelfth bristled segment. The hook-rows are short dorsally, long ventrally in the posterior region. There are two pairs of cephalic ganglia, and the great nerve-cords have neural canals. The alimentary canal has a papillose proboscis, œsophagus, oval stomach and a gut which terminates on the last segment, the anus having a short ventral lobe. The segmental organs occur in every segment, and probably open between the dorsal and ventral feet, though he found another pore on each side behind it. He did not notice the sexual apertures with the hooks, his example being a female. Externally was a parasitic *Loxosoma*.

HETEROMASTUS FILIFORMIS, *Claparède*, 1868.

Specific Characters.—The cephalic region agrees with that of the type (Claparède), and so with the proboscis, which has clavate papillæ. The body reaches the length of 6 cm.,

and there are over 100 segments. The digestive and the perivisceral systems agree with *Capitella*. The anterior segments are short and broad, the posterior long and narrow. The anterior bristles are winged, the posterior region has the characteristic hooks dorsally and ventrally.

SYNONYMS.

1857. *Capitella fimbriata*, van Beneden, p. 139, Bull. l'Acad. Roy. Belg.
 1859. „ „ D'Udekem. Mém. Acad. Roy. Belg., t. 31, p. 26.
 1864. „ *filiformis*, Claparède. Glanures Zoot., p. 49, pl. iv, fig. 10.
 1865. *Aucistria minima*, De Quatrefages. Annelés, ii, p. 252, pl. xi, figs. 28—34.
 1868. *Capitella filiformis*, Claparède. Annél. Neap., p. 273.
 „ „ *castanea*, idem. Ibid., p. 275, pl. xxvii, fig. 2.
 1873. *Aucistria capillaris*, Verrill. Americ. Assoc. Proc., xxii (Explor. Casco Bay), p. 385.
 1874. *Arenia*, sp. (= *Notomastus capillaris*, Verrill). Amer. Journ. Sc., vol. vii, p. 39, and p. 385 as above.
 1881. „ idem. New Engl. Annel., p. 305.
 1887. *Capitella fimbriata*, Eisig. Capitell., p. 839, Taf. i, fig. 4; Taf. xxvii, figs. 16—19; Taf. xxxii, figs. 17—18; Taf. xxxv, fig. 37; Taf. xxxiii, figs. 17—18; Taf. xxxiv, fig. 37; Taf. xxxviii, fig. 9.
 1915. *Aucistria minima*, Allen. Journ. M. B. A., vol. x, p. 638.
 1922. *Heteromastus filiformis*, McIntosh. Ann. Nat. Hist., ser. 9, vol. ix, p. 25.

Habitat.—In sand west of Salthouse Lake, Plymouth (Allen).

Distribution.—Rochelle (De Quatrefages); Mediterranean (Eisig); United States of America (Verrill).

FAMILY MALDANIDÆ.

HETEROCLYMENE ROBUSTA, *Arwidsson*.

Two examples come from Plymouth, and I have to thank Dr. Allen for the opportunity of examining them. Besides the lateral notches in the cephalic border, the rim behind has crenations, the median deepest posteriorly. The segments in the middle of the body can be much elongated, one being about an inch and three-quarters. The bristles and rows of hooks project outward on enlargements at the segment-junctions. The anal disc is an exquisite structure, as finely radiate as the operculum of *Serpula vermicularis*, only the anus is in the centre of a cone, over which the radii pass downward and then upward to the minutely crenate edge. The mid-ventral cirrus is somewhat flattened as well as longest, and there are three or four shorter cirri on each side, rather irregularly arranged, a portion of the dorsal edge being bare.

The tube is as thick as that of *Lanice conchilega*, but firmer, retaining its cylindrical form until somewhat severe pressure is applied. It is composed of shell-fragments, minute shells, spines of Echinoderms, smoothly filled in with fine grains of sand and secretion.

CÆSICIRRUS NEGLECTUS, *Arwidsson* (=PSEUDOCLYMENE CÆRSTEDI, *Claparède*).

All that is known of the coloration of this (by no means uncommon) species is the remark by Cunningham and Ramage¹ in their "Polychæt Fauna of the Firth of Forth," that in their "*Axiothea catenata* the colour is pinkish, pale towards the anterior end, with broad bands surrounding the body at intervals." The region whence these authors drew their supply has since altered its character, probably from pollution, so that a careful search was unsuccessful. It lives gregariously in tubes of sand-particles sunk in the sand. In examples from Wales² the anterior end of the annelid is somewhat pale, though the median vessel causes a streak along the dorsum, the blood at the same time tinting the cephalic plate. In front of the third bristle-tuft the region has a smooth and glistening cuticular coat, which is iridescent, and at the segment-junction in front of the tuft (third) a faint reddish belt apparently from a blood-vessel occurs. The next segment-junction has a belt of red on each side of it, apparently of reddish pigment, the specks of which pass a short way on the following segment (fifth bristled), which has its bristle-tuft about the middle. Then there is a slight constriction of the body-wall, at which a broad red belt occurs, a bristle-tuft (sixth) being placed just in front of another red belt, which passes all round the body. The next bristle-tuft (seventh) is in front of a furrow, marking another segment, the anterior third of which has the broadest band of red yet met with in front. This is followed by a pale region ending at the next bristle-tuft (eighth), and concluding the specially differentiated region anteriorly, the seventh and eighth tufts being separated by a long interval.

The next segment and half of the following are coloured, except at the margins, by a longitudinal belt of red, apparently along the intestine, probably from an intestinal sinus, and thereafter the reddish hue is due to the longitudinal and circular vessels, especially those of the gut, the tip of the tail and its cirri being pale. In these examples the majority of the short anal cirri had processes at the tip, as Arwidsson shows in his figure³ and describes as "short, finger-like lobes," some being only bifid, others trifid or quadrifid, whilst each of the processes in a bifid form may have two or more minor papillæ at the tip. Occasionally the cirrus ends in a bluntly conical apex with a minute papilla at each side near the apex. The gut itself is yellowish or pale orange.

The proboscis, which is constantly protruded by the animal when removed from its tube, shows a tinge of red from a blood-vessel along the middle, and its distal region appears to be smooth.

The exact position of this form has been for some time open to doubt, and I agree with Prof. Fauvel, who, from an ample supply of living specimens on the French coast, has ascertained that "it is nothing else than the old and well-known *Clymene ærstedii* of Claparède." The identity of the anterior and posterior ends and of the bristles and hooks of the two forms is obvious on contrasting them in the respective plates.

¹ 'Trans. Roy. Soc. Edin.,' vol. xxxiii, p. 679, etc., 1888.

² I am indebted to Mr. Arnold Watson for living examples.

³ 'Proc. Roy. Irish Acad.,' vol. xxix, No. 6, p. 129.

PETALOPROCTUS TERRICOLA, *De Quatrefages*, 1865. Plate CXXXVI, fig. 17—bristle, 17*a*—large spine, 17*b*—hook.

Specific Characters.—Head fused with the buccal segment, and without a marginal ridge. Body about 18 cm. long, 2—3 mm. broad, and of twenty-four segments, twenty-two of which are setigerous. First segment distinctly separated from the buccal. First three segments have no ventral division. In the others there are two ventral tori, each with about forty crotchets. Dorsal bristles strong; yellow and winged, and others colourless, not winged, spinous. Behind the sixth or seventh segment are capillary bristles, sinuous and long (overlooked by Claparède and Grube), with minute spines. In seven or eight posterior segments in front of the anal, between the dorsal and ventral divisions, is a fleshy process, adherent dorsally and pointing ventrally, separated by the two setigerous processes at the tori, and resembling those of *Maldane cristagalli*, Claparède. Anal segment achætous; anus near the ventral edge, whereas in *Maldane* it opens toward the dorsum. Two or three furrows are prolonged from the ventral to the dorsal surface, which De St. Joseph regarded as rudiments of segments.

SYNONYMS.

1855. *Clymene spatulata*, Grube. Arch. f. Naturges., p. 114, pl. iv, figs. 12 and 13.
 1865. *Petaloproctus terricola*, De Quatrefages. Annel., t. ii, p. 247.
 1869. *Clymene spatulata*, Grube. Abhandl. Schles. Gesellsch., p. 127.
 1870. *Petaloproctus terricola*, idem. Arch. f. Naturges. (Jahr. 56), p. 317.
 1894. „ „ De St. Joseph. Ann. Sc. nat., 8^e sér., t. xvii, p. 144.
 1914. „ „ Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 135.
 1922. „ „ McIntosh. Ann. Nat. Hist., ser. 9, vol. ix, p. 26.

Habitat.—Blacksod Bay, Ireland (Southern).

Abroad it occurs on the Atlantic and Mediterranean shores of France, St. Sébastien (De Quatrefages), Rocher-Vidé (De St. Joseph).

The *cephalic region* of a specimen sent by Mr. Southern from Blacksod Bay resembles that in *Nicomache*, though somewhat longer, and more projecting ventrally. A keel arises a little above the mouth and runs vertically to the dorsal edge. The surface is speckled with pigment as in *Nicomache maculata*. Each of the three following segments bears a spine below the dorsal tuft of bristles, four of these tufts characterising the anterior region. Three long segments follow those with the spines, the third the longest, with two hook-rows, viz., an anterior and a posterior. This segment is of softer consistence than those in front. The anal plate has an expanded, smooth margin which projects freely all round except dorsally, and has the anus on its posterior surface a little within the broad ventral rim, and it shows a radiate arrangement at its margin. Apparently two narrow rings next it are achætous; that in front of these has a row of hooks and a tuft of bristles of considerable length. The dorsal surface of the third, fourth, fifth and sixth segments in front of the anal plate presents a median conical free flap pointing backward, the third having a pedicled process like a *Loxosoma* attached to it. These eminences increase in prominence from the sixth backward.

The bristles of the first region (four segments) are pale golden and brittle, having a straight shaft, and a curved, finely tapered tip (Plate CXXXVI, fig. 17) with narrow wings. The spine in these segments is stout, golden, and pointed, the tip being slightly hooked (Plate CXXXVI, fig. 17*a*).

The bristles of the middle region are pale-golden and of two kinds, a stronger series of about five with stout shafts and tapering, winged tips, and a more numerous group of slender capillary bristles which extend considerably beyond the former. The tips of the stout series in front of the tail are somewhat longer, but the capillary bristles are shorter, for they do not reach the extremities of the stout forms.

The hooks in the smaller example are stout and rather short, with a base dilating up to the shoulder, which has a hump posteriorly; then the neck is narrowed where it is grasped by the cuticle, again dilates toward the main fang, a distinct bulge occurring below the origin of the gular bristle, where it is again narrowed below the main fang, which is curved at less than a right angle to the neck, and has four teeth above it. The neck and shaft are boldly striated. In the larger specimen the main fang leaves the neck nearly at a right angle, and above it are four prominent teeth. The gular bristle appears to be single, and sometimes curves beyond the main fang and over it (Plate CXXXVI, fig. 17*b*).

MICROMALDANE ORNITHOCHÆTA, *Mesnil*, 1897. Plate CXXXVI, fig. 18—body, 18*a*—bristle, 18*b*—hook.

Specific Characters.—Cephalic region (prostomium) somewhat clavate and symmetrically rounded (elliptical) when seen from above; irregularly clavate in lateral view, ventrally the snout slopes backward and slightly upward to the mouth. Two pairs of eyes, and two longitudinal grooves (nuchal organs). Two gular bristles (or none?). Body comparatively small, 4 mm. in length, and having nineteen segments, seventeen of which are setigerous, enlarged anteriorly, cylindrical in the middle and tapering to the truncated posterior end. The middle region consists of two elongated segments, whilst the achætous caudal is crenated from the various rings, with a small papilla (anus) on the truncated end. Glands abound in the body-wall. Bristles somewhat resemble a pointed assegai or sharp spear, the shaft being stout. Hooks minute, shaft rudimentary, enlarging into a bulbous shoulder, above which is a rather thick neck, and in general shape resembling those of *Lumbriclymene minor*, Arwidsson, or approaching that of a Sabellarian.

SYNONYMS.

1897. *Micromaldane ornithochæta*, Mesnil. Bull. Sci. Fr. et Belg., t. xxx, p. 146, text-figs. 1 and 2.
 1914. „ „ Southern. Proc. Roy. Irish Acad., vol. xxxi, No. 47, p. 134.
 1922. „ „ McIntosh. Ann. Nat. Hist., ser. 9, vol. ix, p. 28.

Habitat.—Dredged in Clew Bay, 9—11 fathoms, and at Howth, in Laminarian roots (Southern).

Abroad it has been found in the cavities of Lithothamnion at La Hague, near Cherbourg (Mesnil).

A minute form, measuring 4 mm. long, the *cephalic region* when viewed from above

being somewhat clavate and symmetrically rounded (elliptical). In lateral view it is irregularly clavate, the dorsal outline being smoothly curved and ending ventrally in the projecting snout, which slopes backward and slightly upward to the mouth.

The *body* (Plate CXXXVI, fig. 18) is comparatively short, consisting of nineteen segments, seventeen of which are bristled. It is enlarged anteriorly, is cylindrical in the middle, and tapers posteriorly to the truncated posterior end. The middle region consists of two long segments. The caudal part is crenated from the various rings, and the achæitous last segment is truncated distally with a small papilla, probably representing the anus. Glands are distributed extensively in the body-wall.

The bristles (Plate CXXXVI, fig. 18*a*) have the shape of a pointed assegai or sharp spear, the cylindrical shaft being stout, and the tip a flattened, translucent spear-point.

The hooks (Plate CXXXVI, fig. 18*b*) are minute, apparently few in number, have a rudimentary shaft, which enlarges into a bulbous shoulder, above which the neck is rather thick. The main fang is curved downward at considerably less than a right angle to the neck, and the crown of the hook is high, with five or six teeth above the large fang. In general shape these hooks somewhat resemble those of *Lumbriclymene minor*, Arwidsson. No gular bristles are present in the specimen. Mesnil thought the hook resembled an avicular Sabellarian bristle, and that it showed the evolution of a Maldanid toward that group. Such views, however, are conjectural. He found one example containing greyish ova.

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TO

A MONOGRAPH

OF THE

BRITISH MARINE ANNELIDS.

VOLS. I—IV.

WITH A COLLATION OF THE PARTS AS ISSUED.

COMPILED BY

GEORGE A. SMITH,

BRITISH MUSEUM (NATURAL HISTORY).

NOTE.—Large roman numerals refer to the volumes, small numerals to the parts; *ic* indicates Part i continued; *f* refers to one or several following pages; *n* indicates a foot-note. The more important page references are indicated by black type.

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- [Vol. I,] Pt. i (*contd.*), 1874 THE NEMERTEANS. Series and Part Titles [i—iv], 97—214, Appendix 213*a*—213*d*, Pls. XI—XXIII.
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- Vol. II, Pt. i, 1908 . . . POLYCHÆTA. Nephthydidæ to Syllidæ. Series and Part Titles [i—iv], Dedication [v, vi], Temporary Preface vii, viii, 1—232, Errata (1 p.), Pls. XLIII—L, LVII—LXX.
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- Vol. II, Pt. ii, 1910 . . . POLYCHÆTA. Syllidæ to Ariciidæ. Series and Part Titles [i—iv], Temporary Preface [v, vi], 233—524, including an Index to Vol. II, Pls. LI—LVI, LXXI—LXXXVII, Index to Vol. I, 443, 444.
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- Vol. III, Pt. ii, 1915 . . . POLYCHÆTA. Opheliidæ to Ammocharidæ. Plates, Series and Part Titles [i—iv], Council's announcement [v, vi], Title Vol. III (1 p.), LXXXVIII—CXI, Title and Contents of Vol. I (2 pp.), Title and Contents of Vol. II (2 pp.).
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- 1920 . . . Coloured Plates LXXXVIII—XCIII, issued with wrapper, to replace uncoloured Plates LXXXVIII—XCIII, sent out in Vol. III, pt. ii, 1915.
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- Vol. IV, Pt. i, 1922 . . . POLYCHÆTA. Hermellidæ to Sabellidæ. Series and Part Titles [i—iv], Contents v, vi, Council's announcement (1 p.), Explanation of letters used in the text-figures (1 p.), 1—250, Pls. CXII, CXIII, CXIII*a*, CXIV, CXVIII—CXXV, CXXV*a*, CXXVI, CXXVII.
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- Vol. IV, Pt. ii, 1923 . . . POLYCHÆTA. Sabellidæ to Serpulidæ and additional species. Series and Part Titles and Title Vol. IV [i—vi], Contents vii, viii, Preface and Council's announcement ix—xi, Errata [xii], 251—498, Index to Vols. I—IV, 499—538, Collation of the Parts as issued 539, Pls. CXV—CXVII, CXXVIII—CXXXVIII.
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PLATE CXV.

FIG.

1. *Bispira volutacornis*, Montagu. Lateral view of body, from Plymouth. Enlarged under a lens.
- 1 *a*. Dorsal view of anterior end. Enlarged under a lens.
- 1 *b*. Lateral view of the same region. Enlarged under a lens.
- 1 *c*. Pale young example. Enlarged under a lens.
2. *Branchiomma vesiculosum*, Montagu, from Plymouth. Enlarged under a lens.
- 2 *a*. Tube of the foregoing. Enlarged under a lens.
3. *Oria Armandi*, Claparède, from the ventral surface. Enlarged.
4. *Amphiglena mediterranea*, Leydig, from the dorsal surface, showing the eyes. Enlarged.
5. *Trichobranchus glacialis*, Malmgren. Dorsum in life. Lochmaddy, North Uist. Enlarged under a lens.
- 5 *a*. Lateral view of a spirit-preparation from St. Magnus Bay, Shetland. Enlarged under a lens.
6. Tube of *Protula tubularia*, Montagu, from Shetland, with an *Actinia* attached. Slightly enlarged.

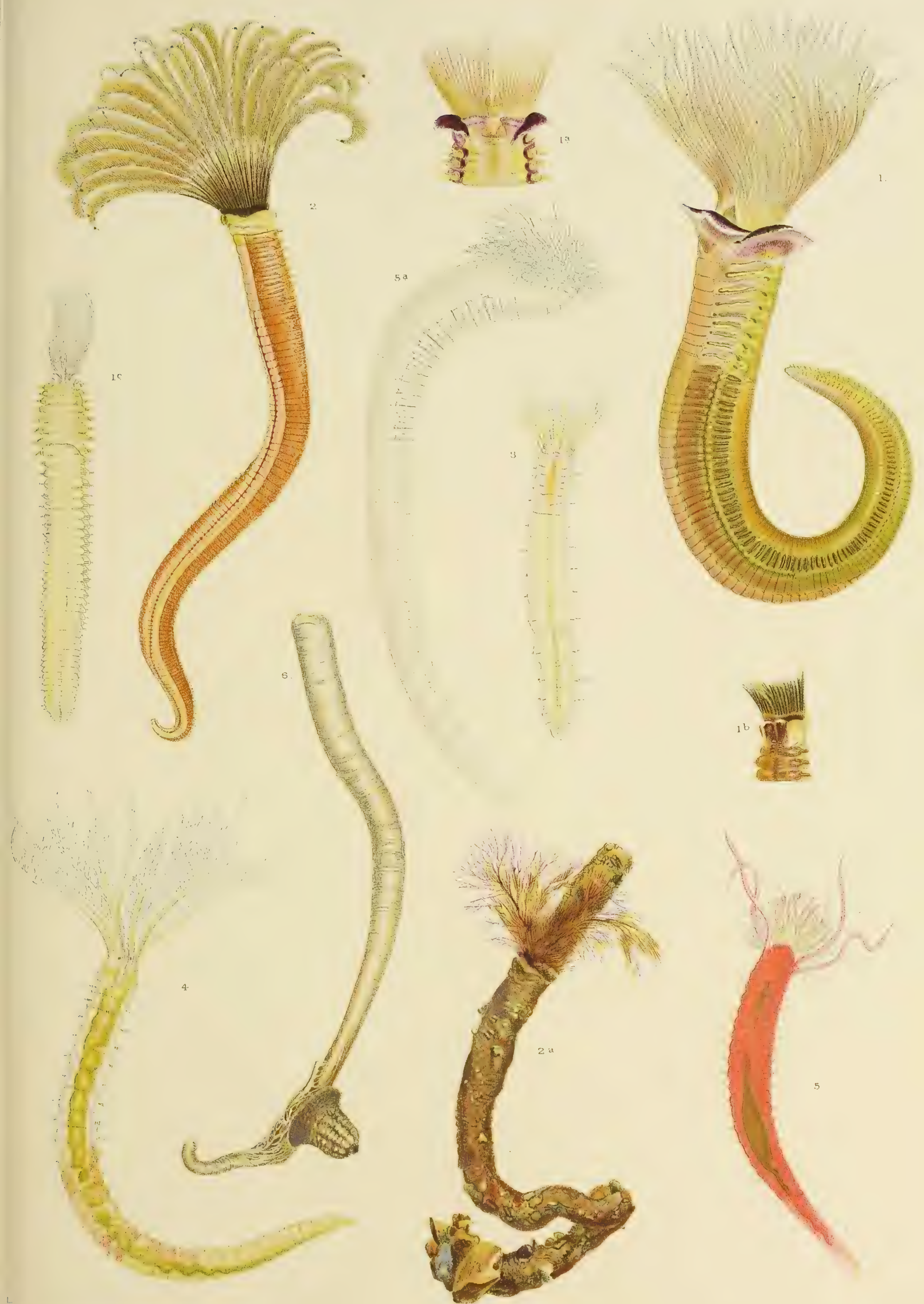


Fig 3, R.M.; Fig. 5, W.C.M.; cetera A.H.W. del

PLATE CXVI.

FIG.

1. *Myxicola viridis*, Milne Edwards, from the neighbourhood of the Bell Rock, St. Andrews Bay. Enlarged.
- 1 *a*. Branchiæ, showing spiral twist. Enlarged.
2. Lateral view of *Protula tubularia*, Montagu, from Plymouth. Enlarged.
3. Lateral view of *Hydroides norvegica*, Gunner, from St. Andrews. Enlarged.
4. *Serpula vermicularis*, L.; tube, with animal internally, attached to *Pecten opercularis*. Enlarged.
- 4 *a*. *Serpula vermicularis*, L. Group attached to *Nassa*. Enlarged.
5. Anterior end of *Filograna implexa*, Berkeley, Plymouth, projecting from its tube. Magnified.
- 5 *a*. The same with bud almost detached posteriorly. Magnified.
- 5 *b*. The same with an operculum and groups of reddish ova. Magnified.
6. Portion of tube of *Amphictene auricoma*, O. F. Müller. Enlarged. Drawn by Rev. J. M. Anderson, M.A., B.Sc., under a lens.
7. Anterior edge of pelagic tube of young *Lagis koreni*, Malmgren, 30th June, 1891. $\times 350$ diam.
- 7 *a*. Posterior edge of the same. $\times 350$ diam.
8. Operculum of *Filograna implexa*, Berkeley. Magnified.
9. Head of *Leptonereis glauca*, after Claparède.



PLATE CXVII.

FIG.

1. *Pomatoceros triqueter*, L., removed from its tube. St. Andrews. Enlarged.
- 1 *a*. The same species projecting from its tube. St. Andrews. Enlarged.
- 1 *b*. Group of tubes of the foregoing. St. Andrews.
2. Group of tubes of *Filograna implexa*, Berkeley, with the annelids projecting from them. Plymouth. Enlarged.
- 2 *a*. Body of an example without a bud, but bearing reddish ova. The branchiæ are omitted.
- 2 *b*. Another with a commencing bud. Plymouth. Enlarged.
- 2 *c*. Bud further advanced in an example from Plymouth. Enlarged.
- 2 *d*. Anterior region of a young example with an operculum. Enlarged.
- 2 *e*. Ventro-lateral view of a young specimen with ova and few thoracic bristles. Enlarged.
3. *Manayunkia* (*Haplobranchus*) *æstuaris*, Bourne, from Sheppey. Enlarged.
- 3 *a*. Anterior region of the same. Magnified.



PLATE CXXVIII.

FIG.

- 1 and 1'. Geniculate posterior bristles of *Sabella*, B.C. (var. of *Potamilla Torelli*, Malmgren). \times oc. 4, obj. D.
- 1 a. Anterior winged bristle. \times oc. 2, obj. D.
- 1 b. Anterior hook. \times oc. 4, obj. D, with draw-tube.
- 1 c. Posterior hook. \times oc. 4, obj. D, with draw-tube.
2. Anterior bristle of *Potamilla reniformis*, Leuckart. \times oc. 2, obj. D, with draw-tube.
- 2 a. Anterior spatulate bristle. \times oc. 4, obj. D.
- 2 b. Spatulate form with broader wings. \times oc. 4, obj. D.
- 2 c. Posterior geniculate bristle. \times oc. 2, obj. D.
- 2 d. Minute flag-like forms accompanying hooks. \times 900.
- 2 e. Anterior hook. \times 900.
- 2 f, 2 f'. Posterior hooks. \times oc. 4, obj. D, with draw-tube.
3. Winged anterior bristle of *Potamilla Torelli*, Malmgren. \times oc. 4, obj. D.
- 3 a. Broadly winged (spatulate) bristle. \times oc. 4, obj. D.
- 3 b, 3 b'. Posterior bristles. \times oc. 4, obj. D.
- 3 c. Anterior hook. \times oc. 4, obj. D, with draw-tube.
- 3 d. Posterior hook. \times oc. 4, obj. D.
4. Simple winged bristle of *Branchiomma vesiculosum*, Montagu. \times oc. 2, obj. F, with draw-tube.
- 4 a. Slightly curved winged form (upper). \times oc. 2, obj. F, with draw-tube.
- 4 b. Posterior geniculate bristle. \times oc. 2, obj. F, with draw-tube.
- 4 c and 4 c'. Antero-posterior view of winged geniculate forms. \times oc. 2, obj. F, with draw-tube.
- 4 d and 4 d'. Bristles with broader wings accompanying hooks. \times oc. 4, obj. F, with draw-tube.
- 4 e. Anterior hook. \times oc. 4, obj. F.
- 4 f. Posterior hook. \times oc. 4, obj. F.
5. Serrated bristle of *Bispira voluticornis*, Montagu, with shorter tip. \times oc. 2, obj. D, with draw-tube.
- 5 a. Anterior bristle with broader tip (knife-blade). \times oc. 2, obj. D.
- 5 b. Long tapering serrated bristle from Plymouth. \times oc. 2, obj. D.
- 5 c. Tip of small bristle accompanying anterior hooks. \times oc. 4, obj. D.
- 5 d. Anterior hook. \times oc. 4, obj. D.
- 5 e. Tip of branchia.
6. Posterior hook of *Dasychone lucullana*, Delle Chiaje, from Naples. \times oc. 4, obj. D.

PLATE CXXIX.

FIG.

- 1 and 1'. Anterior bristles of *Dasychone argus*, Sars, with moderately broad wings.
× oc. 4, obj. D.
- 1". Antero-posterior view of the same. × oc. 4, obj. D.
- 1 a. Tuft of bristles in anterior foot. × 60.
- 1 b and 1 b'. Posterior bristles. × oc. 4, obj. D.
- 1 c. Tuft of bristles in posterior foot. × 60.
- 1 d. Transverse section of the bristles. × 180.
- 1 e. Anterior hook. × oc. 4, obj. D.
- 1 f. Posterior hook. × oc. 4, obj. D.
2. Bristle of *Dasychone lucullana*, Delle Chiaje, with broader wings. × oc. 4, obj. D.
- 2 a. Anterior slender curved bristle from Naples. × oc. 4, obj. D.
- 2 b. Anterior hook. × oc. 4, obj. D.
3. Branchia of *Laonome Kroyeri*, Malmgren. × Beck 1-in.
- 3 a. Tip of bristle with narrow wings. × oc. 4, obj. D, with 1-in. draw-tube.
- 3 b. Bristle with somewhat broader wings. × oc. 4, obj. D, with 1-in. draw-tube.
- 3 c. Oar-shaped bristle with broad wings. × oc. 4, obj. D, with 1-in. draw-tube.
- 3 d. Anterior hook. × oc. 4, obj. D, with 1-in. draw-tube.
- 3 e. Posterior hook. × oc. 4, obj. D, with 1-in. draw-tube.
4. First series of winged bristles of *Jasmineira elegans*, De St. Joseph. × oc. 4,
obj. D, with draw-tube.
- 4 a. Anterior bristle with somewhat wider wings. × oc. 4, obj. D.
- 4 b. Spatulate form. × oc. 4, obj. D.
- 4 c. Long slender form near the tip of the tail. × oc. 4, obj. F.
- 4 d. Long anterior hook. × oc. 4, obj. D, with draw-tube.
- 4 e. Posterior hook. × oc. 4, obj. F.
- 5 and 5'. Anterior winged bristles of *Oria Armandi*, Claparède. × oc. 4, obj. F.
- 5 a. Slender simple bristle. × oc. 4, obj. F.
- 5 b. Anterior long crotchet. × oc. 4, obj. F.
- 5 c. Posterior hook. × oc. 4, obj. F.
6. One of first bristles of *Chone infundibuliformis*, Kröyer. × oc. 2, obj. D.
- 6 a. Posterior bristle. × oc. 2, obj. D.
- 6 b. Anterior hook. × oc. 2, obj. D.
- 6 b'. Two anterior hooks in skin. × oc. 2, obj. D.
- 6 c. Posterior hook. × 700.
7. Anterior bristle of *Amphicora Fabricia*, O. F. Müller. × oc. 4, obj. F, with draw-
tube.
- 7 a. Anterior hook. × oc. 4, obj. F, with draw-tube.
8. Anterior hook of *Euchone rosea*, Langerhans. × oc. 4, obj. F.
- 8 a. Posterior hook. × oc. 4, obj. F.
9. Ovum of *Nicolea venustula*, Montagu. × oc. 1, obj. D.

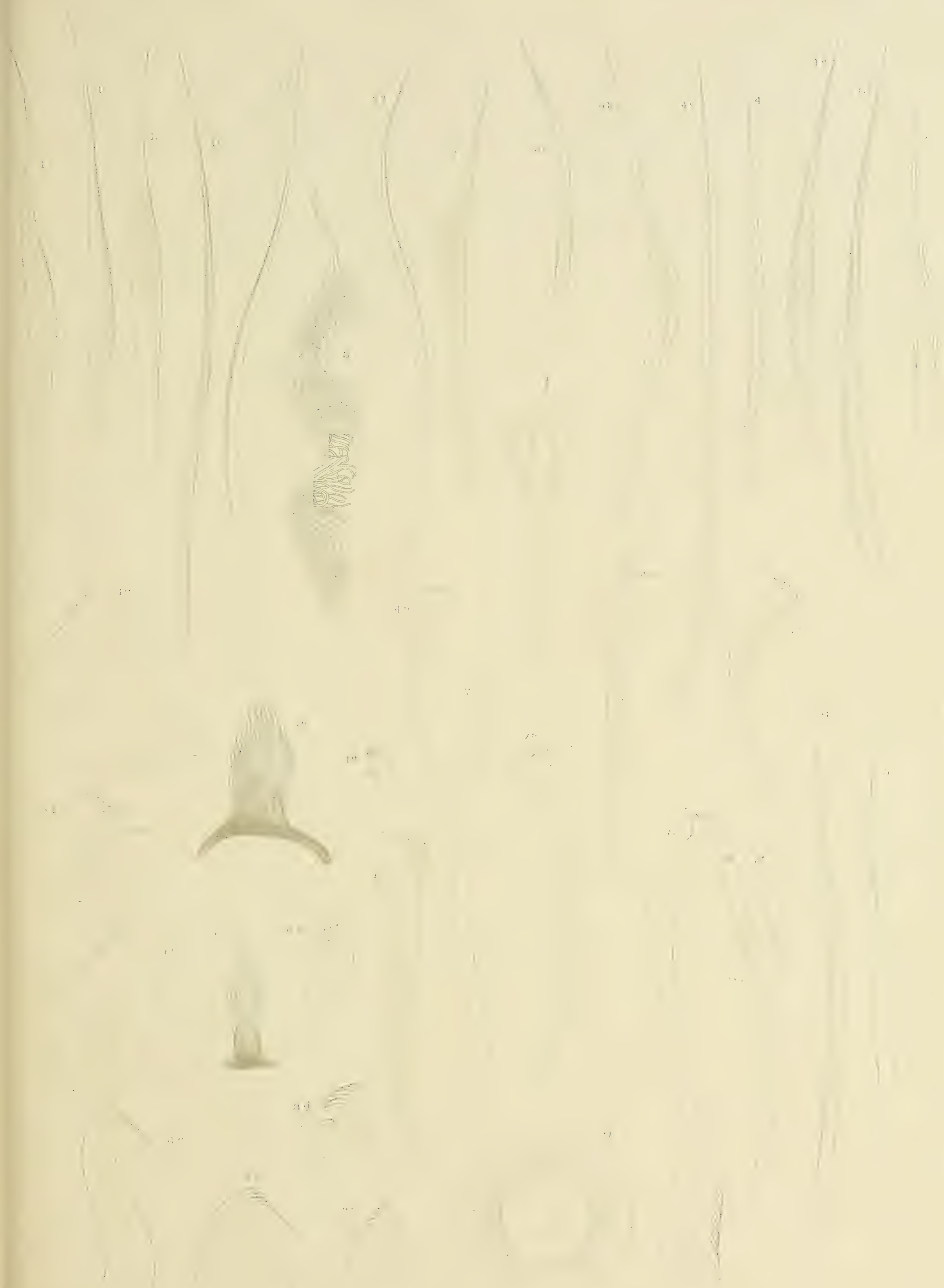


PLATE CXXX.

FIG.

1. Long slightly winged bristle of *Chone Reayi*, McL. × oc. 2, obj. D, with draw-tube.
- 1 *a* and 1 *b*. Paddle-shaped bristles. × oc. 4, obj. D, with draw-tube.
- 1 *c*. Anterior hook. × oc. 4, obj. D, with full draw-tube.
- 1 *d*. Posterior hook. × oc. 4, obj. F.
- 1 *e*. Dorsal view of the collar and pedicle of the branchiæ. Enlarged under a lens.
- 1 *f*. Ventral view of the same. Enlarged under a lens.
2. Paddle-like bristles of *Chone Fauveli*, McL., and sections through the upper part of the shaft. × 280.
- 2 *a*. Shaft of long anterior hook (in section). × 280.
- 2 *b*. Posterior hook of foregoing. × oc. 4, obj. D.
3. Long winged bristle of *Chone Dumeri*, Malmgren. × oc. 4, obj. D, with 1½-in. draw-tube.
- 3 *a*. Oar-shaped bristle. × oc. 4, obj. F.
- 3 *b*. Long anterior hook. × oc. 4, obj. D.
- 3 *c*. Posterior hook. × oc. 4, obj. F.
4. Anterior bristle of *Myxicola infundibulum*, Renier. × oc. 4, obj. F.
- 4 *a*. Posterior bristle. × oc. 4, obj. D, with full draw-tube.
- 4 *b*. Long anterior hook, seen antero-posteriorly. × oc. 4, obj. D.
- 4 *c*. Terminal hook of a row. × oc. 4, obj. D.
5. Long anterior hook of *Myxicola æsthetica*, Claparède. × oc. 4, obj. D, with draw-tube.
- 5 *a*. Posterior hook. × oc. 4, obj. F, with 2-in. draw-tube.
6. Bristle of *Myxicola viridis*, Milne-Edwards. × oc. 4, obj. F.
- 6 *a*. Long anterior hook of same. × oc. 4, obj. F.
- 6 *b*. Posterior hook. × oc. 4, obj. F.
7. Finely tapered anterior bristle of *Protula tubularia*, Montagu, with very narrow wings. × oc. 2, obj. D.
- 7 *a*. Geniculate bristle. × oc. 4, obj. D.
- 7 *b*. Hook. × oc. 4, obj. F.
8. Geniculate bristle of a variety of *Protula tubularia*, Mont., from St. Magnus Bay, Shetland. × oc. 2, obj. D.
- 9 and 9'. Slightly winged bristles of *Hydroides norvegica*, Gunner. × oc. 4, obj. D, with draw-tube.
- 9 *a*. Brush-shaped bristle. × oc. 4, obj. F.
- 9 *b*. Anterior hook. × oc. 4, obj. F.
- 9 *c*. Posterior hook. × oc. 4, obj. D.
10. Anterior bristle of *Serpula vermicularis*, L., with spurs. × oc. 4, obj. D, with draw-tube.
- 10 *a*. Simple, winged, serrated anterior bristle. × oc. 4, obj. D, with draw-tube.
- 10 *b*. Posterior bristle. × oc. 4, obj. D, with draw-tube.
- 10 *c*. Brush-shaped bristle. × oc. 4, obj. F.
11. Tip of the tail of *Cirratulus macintoshi*, Southern. Enlarged.
- 11 *a*. Bristles of the foregoing. × oc. 4, obj. D.
12. Posterior hook of *Chone infundibuliformis*, Kröyer. × oc. 4, obj. D.

PLATE CXXXI.

FIG.

- 1 and 1'. Anterior bristles of *Chone filicaudata*, Southern. \times oc. 4, obj. D, with 1-in. draw-tube.
- 1 a. Long anterior hook. \times oc. 4, obj. D, with 1-in. draw-tube.
- 1 b. Posterior hook. \times oc. 4, obj. F.
- 2 and 2'. Anterior bristles of *Euchone rubrocincta*, Sars. \times oc. 4, obj. D, with 1-in. draw-tube.
- 2 a. Long anterior hook. \times oc. 4, obj. D, with 1-in. draw-tube.
3. Anterior hook of *Serpula vermicularis*, L. \times oc. 4, obj. D, with 2-in. draw-tube.
- 3 a. Posterior hook. \times oc. 4, obj. D.
4. Curved bristle of *Amphiglena mediterranea*, Leydig, with short wings.
- 4 a. Another of the same type seen antero-posteriorly. \times oc. 4, obj. F.
- 4 b. A form with broader wings (spatulate). \times oc. 4, obj. D, with 2-in. draw-tube.
- 4 c and 4 d. Minute bristles (with the tip bent) accompanying the anterior hooks. \times oc. 4, obj. F.
- 4 e. Anterior hook. \times oc. 4, obj. F.
- 4 f. Posterior hook. \times oc. 4, obj. D, with full draw-tube.
5. Tip of branchial filament of *Chone Reayi*, McI. Enlarged.
6. Anterior bristle with a trace of wings from *Euchone rubrocincta*, var. *Normani*, McI. \times oc. 4, obj. D.
- 6 a. Stouter form with serrated wings. \times oc. 4, obj. D.
- 6 b. Long anterior hook. \times oc. 4, obj. F, with 1-in. draw-tube.
- 6 c. Posterior hook. \times oc. 4, obj. D, with $2\frac{1}{2}$ -in. draw-tube.
- 6 d. Posterior bristle with slender tip and narrow wings. \times oc. 4, obj. D.
- 7 and 7 a. Slightly serrated winged bristle of *Pomatocerus triqueter*, L. \times oc. 4, obj. D, with full draw-tube.
- 7 b and 7 b'. Posterior brush-shaped bristles. \times oc. 4, obj. F, and oc. 4, obj. D.
- 7 c. Anterior hook. \times oc. 4, obj. D, with draw-tube.
- 7 d. Posterior hook. \times oc. 2, obj. F, with draw-tube.
8. Slightly winged anterior bristle of *Placostegus tridentatus*, J. C. Fabricius. \times oc. 4, obj. D.
- 8 a. Anterior hook. \times oc. 4, obj. F.
9. Anterior slightly winged bristle of variety of *Placostegus tridentatus*, Fabr. \times oc. 4, obj. D, with 1-in. draw-tube.
- 9 a. Tip of branchial filament. Enlarged.
- 9 b. Anterior hook. \times 500 diam.
10. Tip of branchial filament of *Hydroides norvegica*, Gunner. Enlarged.
11. Operculum of var. of *Placostegus tridentatus*, Fabr., from the "Porcupine." Enlarged.

PLATE CXXXII.

FIG.

1. Winged bristle of *Ditrypa arietina*, O. F. Müller. × oc. 4, obj. D.
- 1*a*. Hook. × oc. 4, obj. D, with full draw-tube.
2. Winged bristle of *Apomatus ampulliferus*, Philippi. × oc. 4, obj. D.
- 2*a*. Sickie-shaped bristle near tail. × oc. 4, obj. D, with full draw-tube.
- 2*b*. Globular operculum. × Beck 2 in. with 2-in. draw-tube.
- 2*c*. Branchiæ and operculum. × Beck 2 in. with 2-in. draw-tube.
3. Winged, curved bristle of *Spirorbis violaceus*, var. *Caulleryi*, McL., from Guernsey.
× oc. 4, obj. F, with 2-in. draw-tube.
- 3*a*, 3*b* and 3*c*. Bristles of the first or collar-series. × oc. 4, obj. D, with full draw-tube.
- 3*d*. Lateral view of tube. Enlarged.
- 3*e*. Aspect of tube from above. Enlarged.
4. Bristle of the first series of *Spirorbis borealis*, Daudin. The bristle is slightly turned
so that the serrations of the basal web are fully shown. × oc. 4, obj. D, with
draw-tube.
- 4*a*. Winged bristle. × oc. 4, obj. F.
- 4*b*. Knife-like posterior bristle. × oc. 4, obj. D, with 2-in. draw-tube.
- 4*c*. Tube. Enlarged under lens.
- 4*d*. Operculum. × oc. 2, obj. A.
- 5, 5' and 5''. Bristle of the first series of *Spirorbis granulatus*, L., the latter from
Guernsey. × oc. 4, obj. D, with draw-tube.
- 5*a*. Anterior capillary bristle. × oc. 4, obj. D, with full draw-tube.
- 5*c*. Collar-bristle laid on its edge so as to be seen from the dorsum. × 360.
- 5*d*. Tubes from St. Andrews. Enlarged under a lens.
6. Collar-bristle of *Spirorbis spirillum*, L. × oc. 4, obj. D, with 2-in. draw-tube.
- 6*a* and 6*a'*. Winged bristles. × oc. 4, obj. D, with full draw-tube.
- 6*b*. Posterior geniculate bristle. × oc. 2, obj. D, with draw-tube.
- 6*c*. Elongated tube. Enlarged under lens.
- 6*d*. Tube in close whorls. Enlarged under lens.
- 6*e*. Operculum. Enlarged under lens.
- 6*f*. Hook from Guernsey. × oc. 4, obj. D, with full draw-tube.
7. Collar-bristle of *Spirorbis militaris*, Claparède, basal web turned round. × oc. 4,
obj. D, with draw-tube.
- 7*a*. Winged bristle. × oc. 4, obj. D, with 2-in. draw-tube.
- 7*b*. Sickie-shaped bristle from the third foot. × oc. 4, obj. F.
8. Anterior bristle of *Myricola æsthetica*, Clap. × 360.

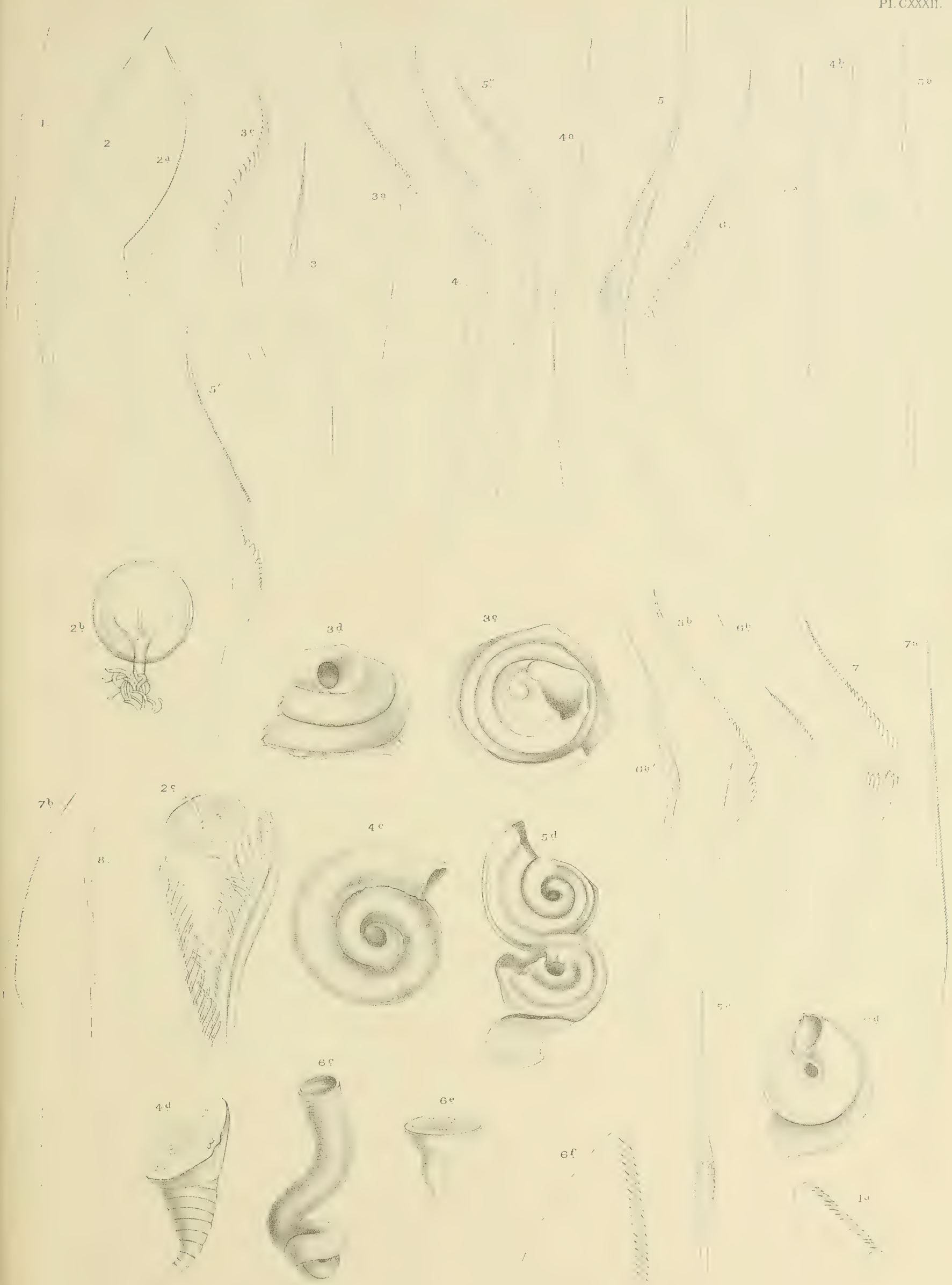


PLATE CXXXIII.

FIG.

1. Rudimentary left operculum of *Hydroides norvegica*, Gunner. Enlarged.
- 1 *a.* Tubes on a valve of *Pecten*. Somewhat enlarged.
- 1 *b.* Trifid bristle (anterior). \times oc. 4, obj. D.
2. Tube of a variety of *Placostegus tridentatus*, Fabr., from the "Porcupine" Expedition of 1870.
3. Collar-bristle of *Spirorbis medius*, Pixell. \times oc. 4, obj. F.
- 3 *a.* Winged bristle. \times oc. 4, obj. D, with 2-in. draw-tube.
- 3 *b.* Geniculate bristle of the posterior region. \times oc. 4, obj. F, with 2-in. draw-tube.
- 3 *c.* Hook. \times oc. 4, obj. F.
4. Operculum of variety of *Placostegus tridentatus*, J. C. Fabricius. Enlarged.
5. Tube of *Spirorbis heterostrophus*, Montagu, from England. Enlarged.
6. Tube of *Spirorbis carinatus*, Montagu. Enlarged.
7. Shorter posterior bristle of *Spirographis Spallanzani*, Viviani. \times oc. 4, obj. D.
- 7 *a.* Longer bristle (anterior). \times oc. 4, obj. D.
- 7 *b.* Anterior hook. \times oc. 4, obj. D.
- 7 *c.* Posterior hook. \times oc. 4, obj. D.
- 8 and 8 *a.* Collar-bristles of *Spirorbis Pagenstecheri*, De Quatrefages, the latter seen antero-posteriorly so as to show the double web at the base. \times oc. 4, obj. F.
9. Long posterior bristle (winged) of *Euchone rubrocincta*, Sars. \times oc. 4, obj. D.
- 9 *a.* Posterior hook. \times oc. 4, obj. F.
10. Long simple bristle of *Apomatus ampulliferus*, Philippi. \times oc. 4, obj. D, with draw-tube.
11. Hook of *Spirorbis borealis*, Daudin. \times oc. 4, obj. F.
12. Operculum of *Spirorbis granulatus*, L., St. Andrews. Enlarged.
- 12 *a.* Branchial filaments. Enlarged.
13. Operculum of *Spirorbis medius*, Pixell, Blacksod Bay. Enlarged.
- 13 *a.* Tip of branchial filament. Enlarged.
14. Operculum of *Spirorbis violaceus*, Levinsen, var. *Caulleryi*, McL. \times oc. 2, obj. A.
15. Sand-tubes of *Sabellaria alveolata*, L., showing funnel-shaped apertures. Slightly enlarged.
16. Operculum of *Filograna implexa*, Berkeley. Magnified.
17. Anterior hook of *Amphicora fabricia*, O. F. Müller. \times oc. 4, obj. D, with full draw-tube.
- 18 and 18 *a.* Anterior bristles of *Nerinides longirostris*, De Quatrefages. \times oc. 4, obj. D.
- 18 *b.* Hook. \times oc. 4, obj. D.
19. Hook of *Nerinides tridentata*, Southern. \times oc. 4, obj. D.

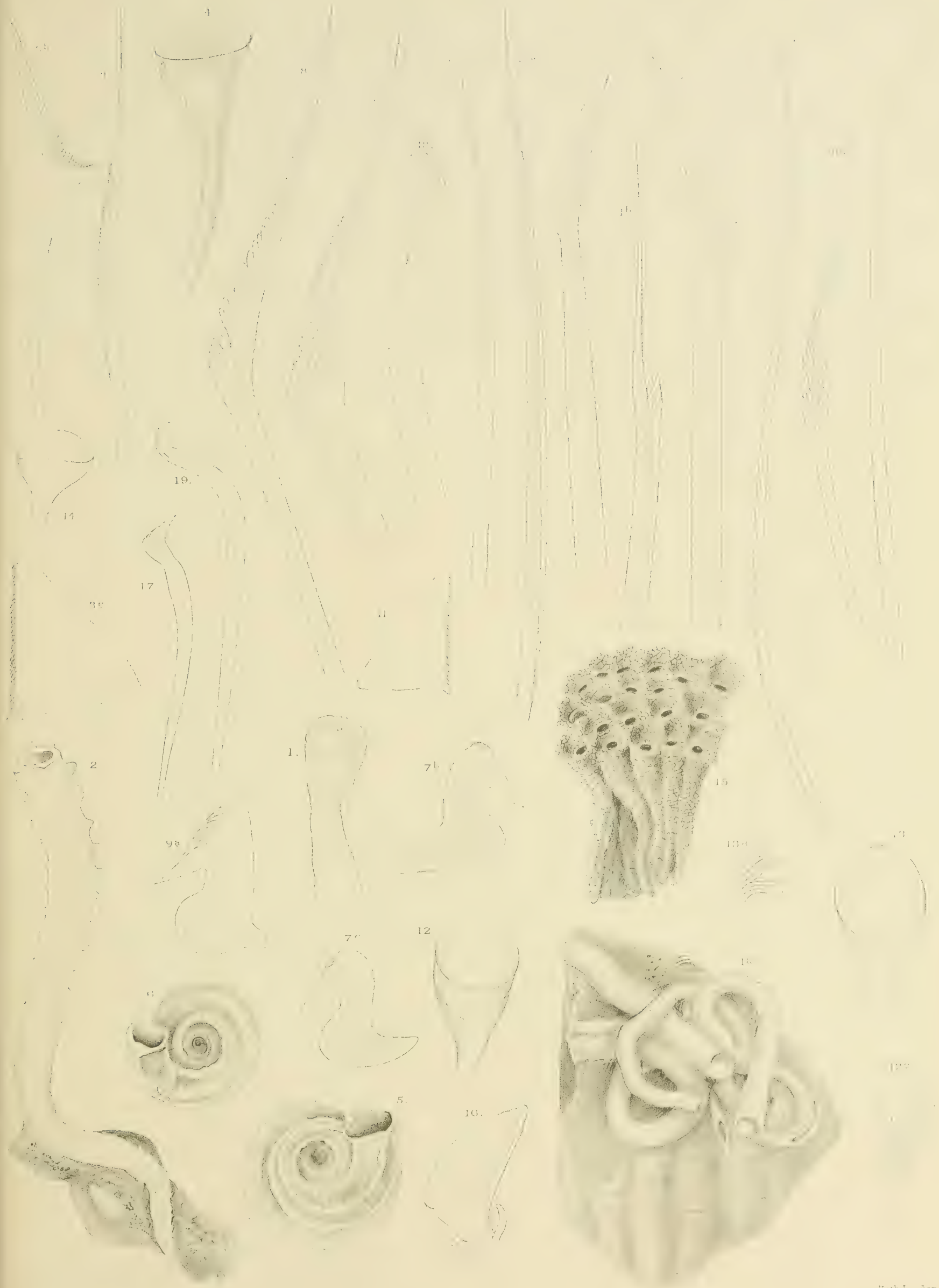


PLATE CXXXIV.

FIG.

1. *Lepidasthenia argus*, Hodgson. About nat. size.
- 1 *a*. Head with proboscis extruded. Enlarged.
- 1 *b*. Proboscis with teeth seen from the front. Enlarged.
- 1 *c*. Anterior scale. × Beck 3-in., with 1-in. draw-tube.
- 1 *d*. Anterior foot. × Beck oc. 1, obj. 3-in.
- 1 *e*. Seventieth foot showing segmental organ. × Beck oc. 1, obj. 3-in.
- 1 *f*. Simple dorsal (posterior) bristle. × oc. 4, obj. A.
- 1 *g* and 1 *g'*. Ventral bristles, the latter with the tip more highly magnified. × oc. 4, obj. A, and oc. 2, obj. D.
2. Dorsal bristle of *Eucranta villosa*, Malmgren. × oc. 4, obj. D.
- 2 *a*. Upper ventral bristle with bifid tip. × oc. 4, obj. D.
- 2 *b*. Ventral bristle. × oc. 4, obj. D.
3. Anterior bristle of *Prægeria remota*, Southern. × oc. 4, obj. F.
- 3 *a*. Posterior bristle. × oc. 4, obj. F.
- 3 *b*. Simple hooked bristle. × oc. 4, obj. F.
4. *Pelagobia longicirrata*, Greef, from Port Erin. × oc. 4, obj. A, with 1-in. draw-tube.
- 4 *a*. Later stage with the posterior bristles. × oc. 4, obj. A, with 1-in. draw-tube.
5. Compound bristle of the eleventh foot of *Oxydromus propinquus*, Marion & Bobretzky. × oc. 4, obj. D, with 1-in. draw-tube.
- 5 *a*. Posterior bristle with shorter tip. × oc. 4, obj. F.
6. Lyrate dorsal bristle of *Microphthalmus szcelkowi*, Meczniow. × oc. 4, obj. F.
- 6 *a*. Ventral bristle with shorter tip. × oc. 4, obj. F.
- 6 *b*. Ventral bristle with longer tip. × oc. 4, obj. F.
7. Enlarged view, after preservation, of the head and anterior region of *Eteone depressa*, Malmgren.
- 7 *a*. Similar view of the tip of the tail, supplemented from a sketch by Mr. Arnold Watson.
- 7 *b*. Lateral view of a foot from the anterior third of the body. × about 60 diam.
- 7 *c*. Bristle slightly turned so as to show the serrations on the tip of the shaft. × oc. 4, obj. C.
- 7 *d*. Bristle in lateral view. × oc. 4, obj. F.
8. Bristle of *Eulalia pusilla*, Ersted. × oc. 4, obj. F.
9. Bristle of *Mystides limbata*, De St. Joseph. × oc. 4, obj. F.
10. Anterior bristle of *Mystides bidentata*, Langerhans. × oc. 4, obj. F.
- 11 *a*. Another bristle of the same similarly magnified.
11. Bristle of *Mystides borealis*, Théel. × oc. 4, obj. F.

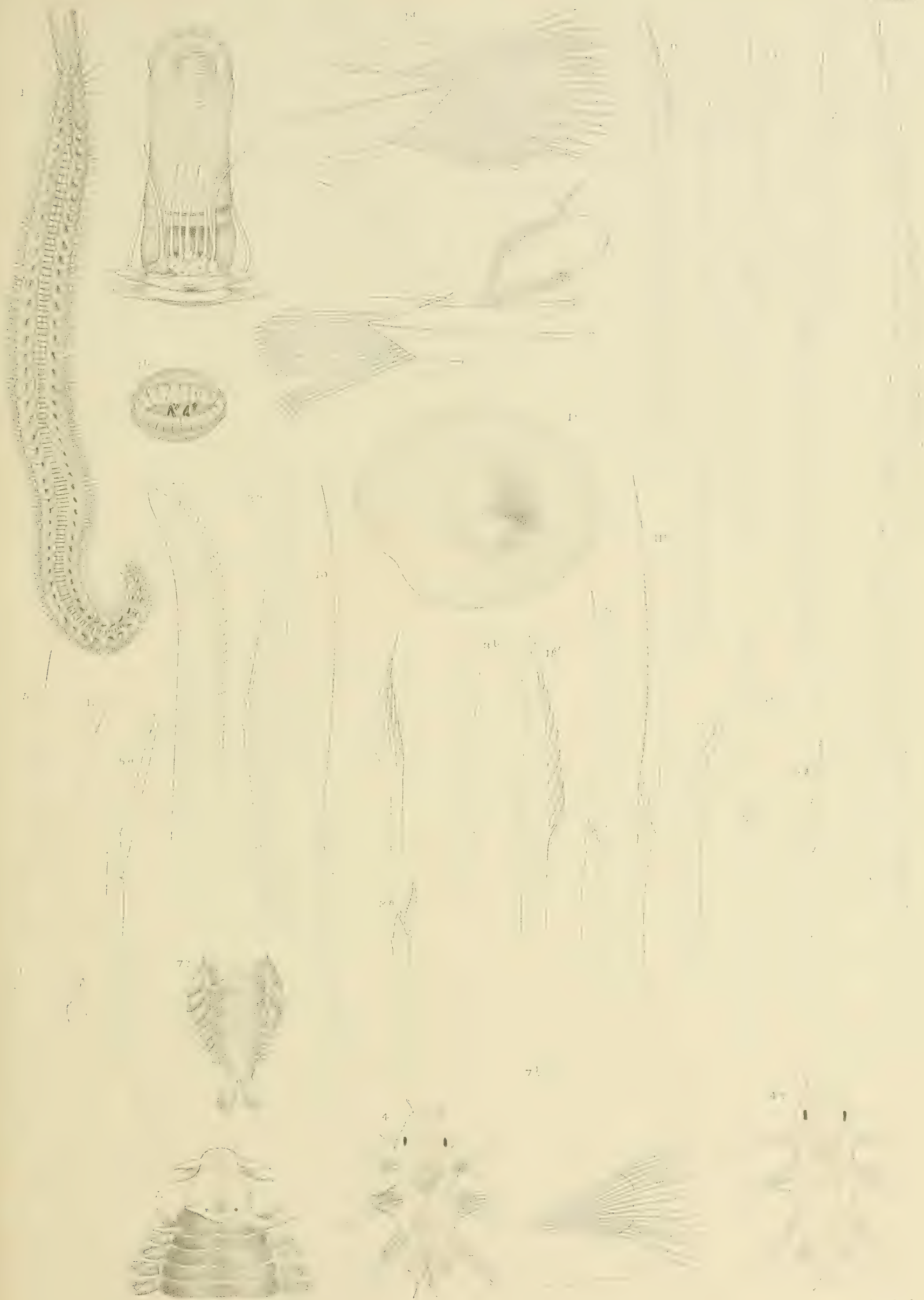


PLATE CXXXV.

FIG.

1. Bristle of *Mystides elongata*, Southern. × oc. 4, obj. F.
- 1 *a.* Another, more or less in profile. × oc. 4, obj. F.
2. Bristle of *Parexogone hebes*, Webster & Benedict. × oc. 4, obj. F.
- 2 *a.* Spine in the dorsal region of the foot. × oc. 4, obj. F.
3. Anterior region of *Procerastea halleziana* (after Malaquin).
- 3 *a.* Tips of the bristles of the same (after Malaquin).
- 3 *b.* Anterior region of female bud (*Sacconereis*) of the foregoing (after Malaquin).
Enlarged.
4. Head of *Grubea limbata*, Claparède (after Claparède).
- 4 *a.* Bristles of the foregoing (after Claparède).
5. Head and anterior end of *Grubea pusilla*, Dujardin (after Claparède). Enlarged.
- 6 and 6 *a.* Bristles of *Sphærosyllis erinaceus*, Claparède. × oc. 4, obj. F.
- 7 anterior, and 7 *a* posterior, bristles of *Sphærosyllis bulbosa*, Southern. × oc. 4, obj. F,
with 2-in. draw-tube.
8. Head and anterior region of *Grubea clavata*, Claparède (after Claparède).
- 8 *a.* Anterior foot of the same. × oc. 2, obj. D.
- 8 *b.* Bristle of the same. × oc. 2, obj. D.
9. Head and anterior region of *Sphærosyllis ovigera*, Langerhans (after Langerhans).
Enlarged.
10. Bristle of *Pionosyllis serrata*, Southern. × oc. 2, obj. F.
11. Bristles of *Autolytus longiferens* (after Malaquin).
- 11 *a.* Posterior bristle of the same. × oc. 4, obj. F.
12. Head and anterior region of *Streptosyllis Websteri*, Southern (after Southern).
- 12 *a.* Bristles of the foregoing (after Southern).
13. *Eusyllis monilicornis*, Malmgren (after Malmgren).
15. Head and anterior region of *Autolytus (Proceræa) macrophthalmus* (after Marenzeller).
- 15 *a* and 15 *b.* Anterior and posterior bristles.
16. Head and anterior region of *Proceræa brachycephala*, Marenzeller (after Marenzeller).
17. Head and anterior region of *Autolytus punctatus*, De St. Joseph (after De St. Joseph).
18. Head and anterior region of *Autolytus Edwardsi*, De St. Joseph (after De St. Joseph).
19. Bristle of *Eteone foliosa*, De Quatrefages, from an Irish specimen. Forwarded by
Mr. Southern. × oc. 4, obj. F, with draw-tube 4.
20. Winged bristle of *Manayunkia (Haplobranchus) æstuaris*, Bourne. × oc. 4, obj. F.
- 20 *a.* Hook of the foregoing. × oc. 4, obj. F.
21. Hook of *Euchone normani*, McI. × oc. 4, obj. F, with 1-in. draw-tube.
- 22 and 22 *a.* Lateral and face-views of the tube of a Terebellid dredged off Valentia.
"Porcupine," 1869. About nat. size.
23. Anterior hook of *Hydroides norvegica*, Gunner. × oc. 4, obj. F.
24. Head and anterior region of *Marphysa fallax*, Marion & Bobretzsky.
- 24 *a.* Foot of the foregoing. Enlarged.
25. The sixtieth foot of *Nerinides longirostris*, De Quatrefages, from Blacksod Bay.
× oc. 2, obj. A.

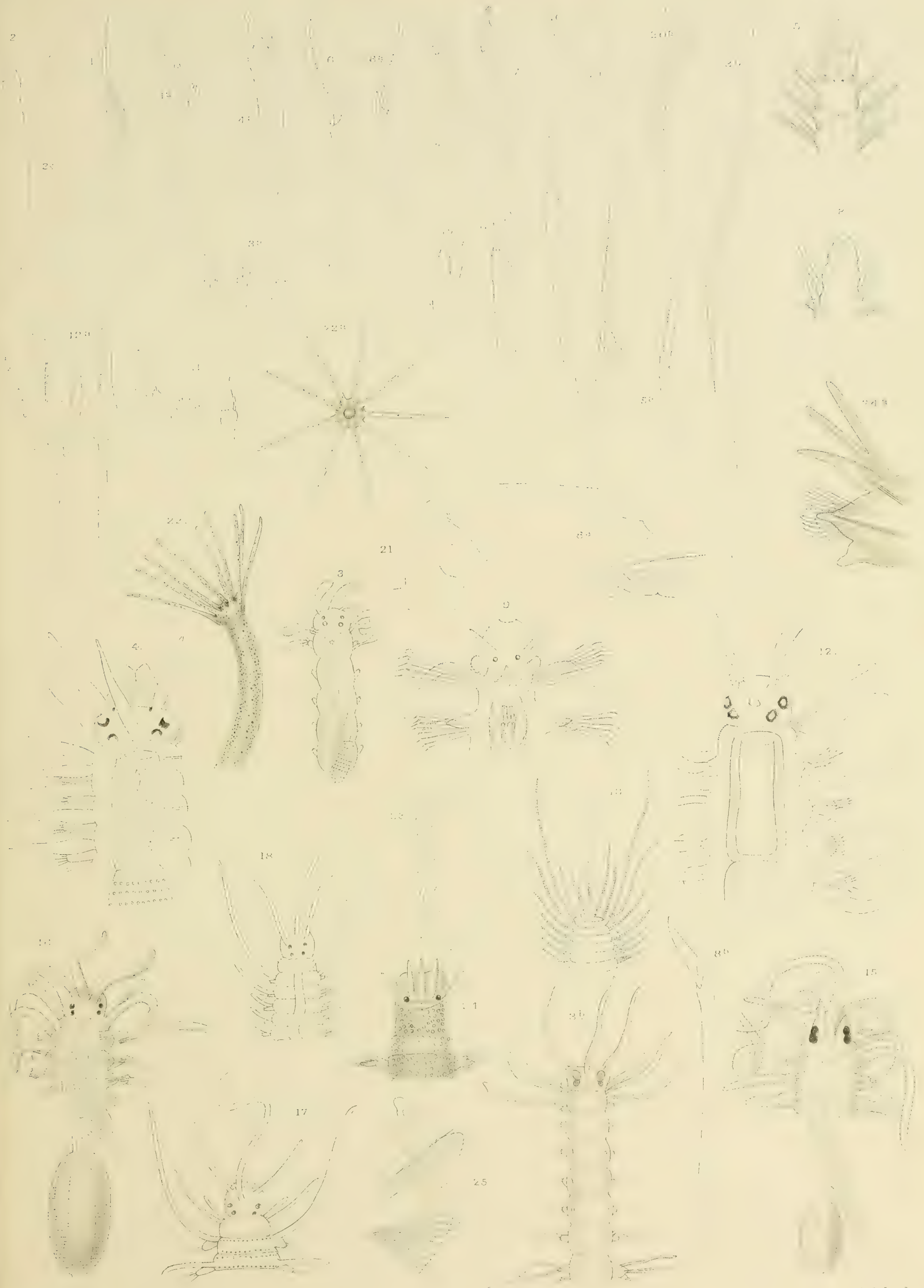


PLATE CXXXVI.

FIG.

1. Dorsal bristle of *Chrysopetalum debile*, Grube, from Clew Bay. \times oc. 4, obj. D.
2. Head and anterior region of *Pholæ tuberculata*, Southern. Enlarged.
3. Dorsal bristle of *Paraonis lyra*, Southern. \times oc. 4, obj. D.
4. Bristle of *Sphærodorum clapedii*, Greef. \times oc. 4, obj. F, with full draw-tube.
- 5 and 5 a. Bristles of *Sphærodorum minutum*, Webster & Benedict. \times oc. 4, obj. F.
6. Anterior foot of *Nerinides longirostris*, De Quatrefages. \times oc. 2, obj. A.
- 6 a. Dorsal bristle of the same. \times oc. 4, obj. D, with full draw-tube.
7. Tenth foot of *Nerinides tridentata*, Southern. \times oc. 2, obj. A.
8. Anterior foot of *Aonides paucibranchiata*, Southern. \times oc. 2, obj. A.
- 8 a and 8 a'. Dorsal bristles of the same. \times oc. 4, obj. D, with full draw-tube.
9. Dorsal bristle of *Polydora cæca*, Örsted. \times oc. 4, obj. F.
10. Curved dorsal bristle of *Pygospio seticornis*, Örsted. \times oc. 4, obj. F.
- 10 a. Dorsal bristle of a more slender type. \times oc. 4, obj. F.
- 10 b. Bristle from the caudal region of the same with enlarged tip. \times oc. 4, obj. F.
11. Hook of *Magelona rosea*, Moore. \times oc. 4, obj. F.
12. Tooth-like bristle of the fourth segment of *Phyllochætopterus anglicus*, Potts. \times oc. 4, obj. D.
- 12 a. Translucent hook from the posterior region of the same. \times 200.
13. Dorsal bristle of *Chætozone killariensis*, Southern. \times oc. 4, obj. F, with 2-in. draw-tube.
14. Dorsal bristle of *Macrochæta clavicornis*, Sars. \times oc. 4, obj. D.
- 14 a. Anterior hook. \times oc. 4, obj. D.
- 14 b. Posterior hook. \times oc. 4, obj. D.
15. Hook of *Chætozone alata*, Southern. \times oc. 4, obj. A.
16. Hook of *Notomastus rubicundus*, Keferstein. \times oc. 4, obj. F.
17. Dorsal bristle of *Petaloproctus terricola*, De Quatrefages. \times oc. 2, obj. D.
- 17 a. Spine. \times oc. 2, obj. D.
- 17 b. Hook. \times oc. 4, obj. D.
18. Outline of *Micromaldane ornithochæta*, Mesnil, from a spirit-preparation. Enlarged.
- 18 a. Dorsal bristle. \times oc. 4, obj. F, with full draw-tube.
- 18 b. Hook. \times oc. 4, obj. F, with full draw-tube.
19. Tube of Terebellid with long sponge-spicules. "Porcupine," 1870, in 690 fathoms, Atlantic. Slightly enlarged.
20. Hook of *Spirorbis violaceus*, Levinsen, var. *Caulleryi*, McL. Viewed somewhat obliquely. \times oc. 4, obj. F.
21. Anterior ventral region of *Lagis koreni*, Malmgren, showing the nuchal organs, *n.* From a photograph by Mr. Arnold Watson. Enlarged.
22. Section through the chordoid anterior region of *Bispira voluticornis*, Montagu. *br. v.*, branchial vessel; *c.*, glandular tissue of collar; *ch.*, chordoid tissue; *m.*, mouth.
23. Anterior bristle of *Hydroïdes norvegica*, Gunner. \times 360.

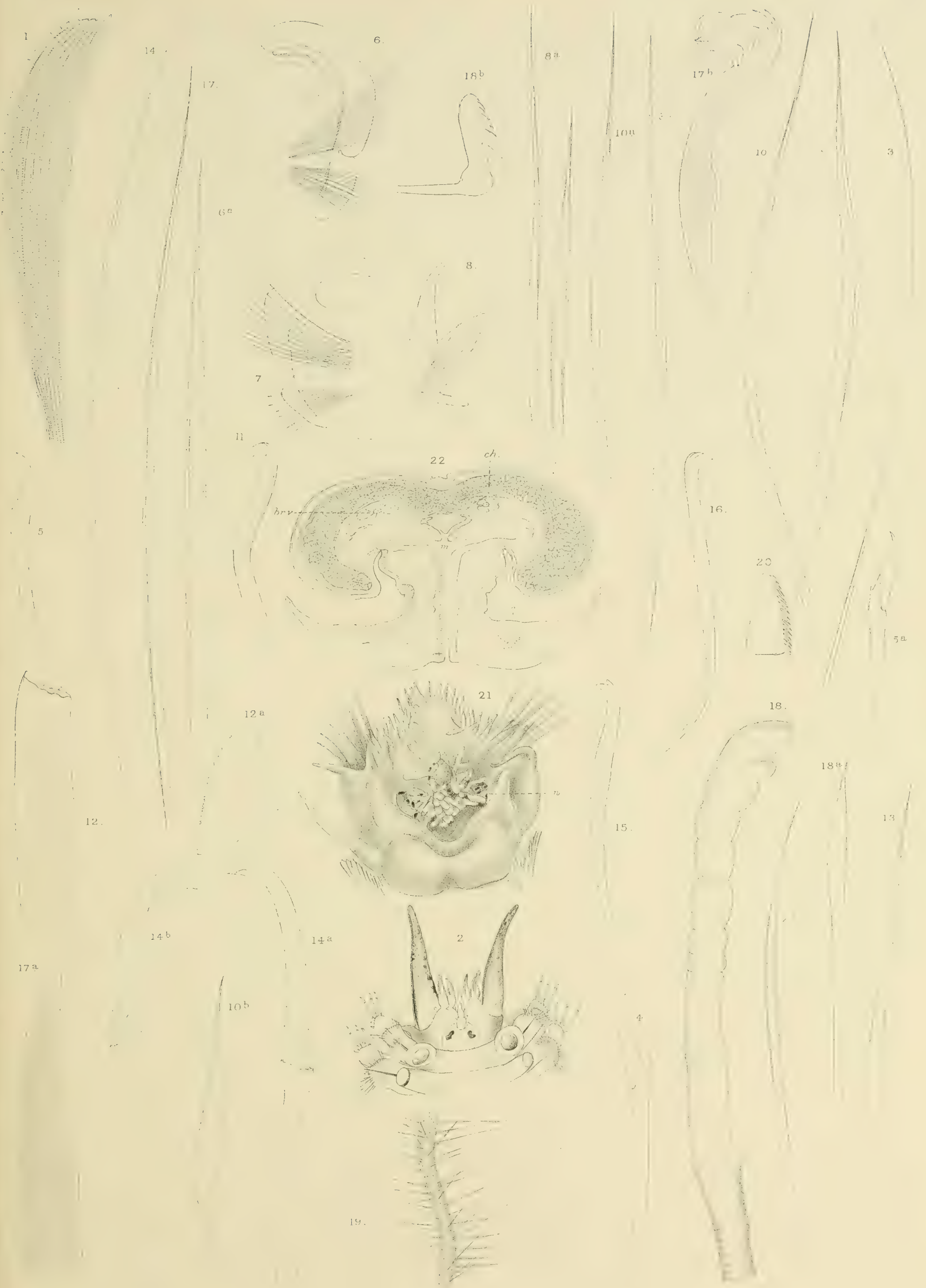


PLATE CXXXVII.

FIG.

1. Foot of *Harmothoe marphysæ*, var. *Watsoni*, McI. × 1-in. Beck.
- 1 *a*. Scale. × 1-in. Beck.
- 1 *b*. Ventral bristle. × 250 diam.
2. Tip of bristle of *Eulalia pusilla*, Erst. × oc. 4, obj. D.
3. Third foot of *Streptosyllis bidentata*, Southern (after Southern). × 330.
4. Thirteenth foot of *Opisthodonta pterochæta*, Southern (after Southern). × 160.
5. Head and anterior region of *Eusyllis lamelligera*, De St. Joseph (after De St. Joseph).
Enlarged.
- 5 *a* and 5 *a'*. Tips of bristles. Enlarged.
6. Head and anterior region of *Autolytus lugens*, De St. Joseph (after De St. Joseph).
Enlarged.
7. *Macrochæta clavicornis*, Sars, from a spirit-preparation sent by Mr. Southern.
Enlarged.
8. Anterior end of *Armandia flagellifera*, Southern (after Southern). × 40.
- 8 *a*. The same with the proboscis extruded (after Southern). × 40.
- 8 *b*. Lateral view of the posterior end (after Southern). × 40.
9. *Cirratulus incertus*, McI. (olim *C. bioculatus*). Enlarged.
10. Bristle of *Spirochætopterus typicus*, Sars, Loch Linnhe. × oc. 4, obj. D.
- 10 *a*. Hook. × oc. 4, obj. D.
11. Hook of *Amphitrite*, C. (near *figulus*). × 360.
12. Tip of branchial filament of *Myxicola æsthetica*, Claparède. Enlarged.
- 12 *a*. Anterior hook. × oc. 4, obj. D, with 2-in. draw-tube.
- 12 *b*. Posterior hook. × oc. 4, obj. D, with 2-in. draw-tube.
13. Caudal bristle of *Sabella*, W., Jersey. × oc. 4, obj. D.
14. Posterior hook of *Potamilla Torelli*, Malmgren. × oc. 4, obj. D.
15. Anterior hook of *Euchone rubrocincta*, Sars. × 360.
- 15 *a*. Posterior hook. × 360.
16. Hook of *Amphicora fabricia*, O. F. M., under pressure. × oc. 4, obj. F, with full
draw-tube.
17. Winged anterior bristle of *Placostegus tridentatus*, J. C. Fab. × oc. 4, obj. D.
- 17 *a*. Bristle from tip of tail. × oc. 4, obj. D, with 2-in. draw-tube.
18. Posterior bristle of *Pomatocerus actinoceros*, Grube. × oc. 4, obj. D.
19. Hook of *Apomatus ampulliferus*, Phil. × oc. 4, obj. F.
20. Collar-bristle of *Filograna implexa*, Berkeley. × oc. 4, obj. F, with draw-tube.
- 20 *a*. Sickle-like bristle. × 360.
- 20 *b*. Caudal bristle. × 360.
- 20 *c*. Hook. × 450.
21. Collar-bristle of "*Salmacina incrustans*," Clap. × 360.
22. Collar-bristle of *Spirorbis granulatus*, L. × oc. 4, obj. F.
23. Tip of a collar-bristle of *Spirorbis Pagenstecheri*, De Quatrefages. × oc. 4, obj. D.

PLATE CXXXVIII.

FIG.

1. *Prægeria remota*, Southern, from St. Andrews. Enlarged.
2. *Sabellides octocirrata*, Sars. (after Malmgren). Enlarged.
3. Tenth foot of *Spio martinensis*, Mesnil. \times oc. 2, obj. A.
- 3 a. Twentieth foot. \times oc. 2, obj. A.
4. Tip of branchial filament of *Branchiomma Kollikeri*, Claparède (var. of *B. vesiculosa*), with eyes. \times oc. 2, obj. A.
5. Anterior hook of *Jasmineira caudata*, Langerhans. \times oc. 4, obj. D, with 2-in. draw-tube.
- 5 a. Posterior hook. \times oc. 4, obj. D, with 2-in. draw-tube.
6. Anterior hook of *Amphitrite grænlandica*, Mgrn. \times oc. 4, obj. D, with 2-in. draw-tube.
- 6 a. Posterior hook. \times oc. 4, obj. D, with 2-in. draw-tube.
7. Tips of four bristles (second and twenty-third) of *Ehlersia ferruginea*, Langerhans (after Langerhans).
8. Simple slender bristle (anterior) of *Asclerocheilus intermedius* (De St. Joseph). \times oc. 4, obj. D, with 2-in. draw-tube.
- 8 a. Sickle-shaped bristle of the second segment. \times oc. 4, obj. D, with 2-in. draw-tube.
- 9 and 9 a. Posterior hooks (at tail) of *Euchone rubrocincta*, Malmgren. \times 360 diam.
10. Powerful hook of the fifth segment of *Polydora cæca*, Erst., from Blacksod Bay. \times oc. 4, obj. D.
- 10 a. Minute penniform bristle accompanying the former. \times oc. 4, obj. D.
- 10 b. Ordinary winged bristle of the anterior region. \times oc. 4, obj. D, with 2-in. draw-tube.
- 11 and 11 a. Large hooks of the fifth foot of *Polydora giardi*, Mesnil. \times oc. 4, obj. D, with 2-in. draw-tube.
12. Portion of the surface of the body of *Macrochæta clavicornis*, Sars, to show the processes. \times oc. 4, obj. A, with 2-in. draw-tube.
13. Lateral view of *Hauchiella tribullata*, McIntosh (after Wollebæk). Slightly enlarged.
- 13 a. Anterior end of the same with its frills and tentacles (after Wollebæk). Enlarged.
- 13 b. The three nephridial discs of the foregoing after the same author. Enlarged.
14. Posterior transparent hook of *Spiochætopterus typicus*, Sars. \times 360 diam.
- 15 and 15 a. Hooks of *Spirorbis granulatus*, L., the latter seen obliquely so as to show the bifid inferior process. \times 360.
16. Anterior hook of *Spirorbis militaris*, Claparède. \times 360.

3

2

10b

11.

10a

15a

4.

7.

14.

13b

13

5.

13a

6

9.

5a

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3.

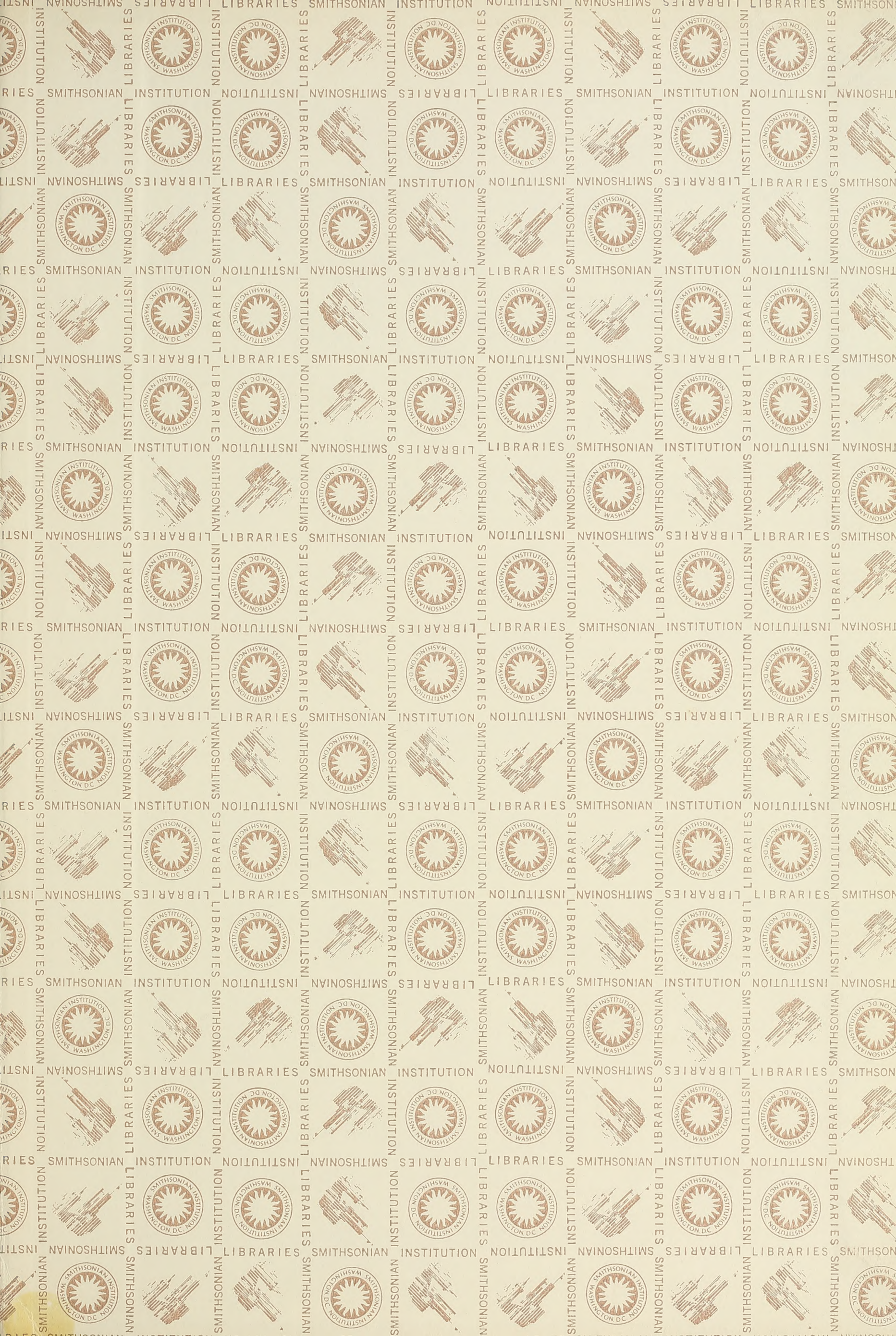
3a

16

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12.





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